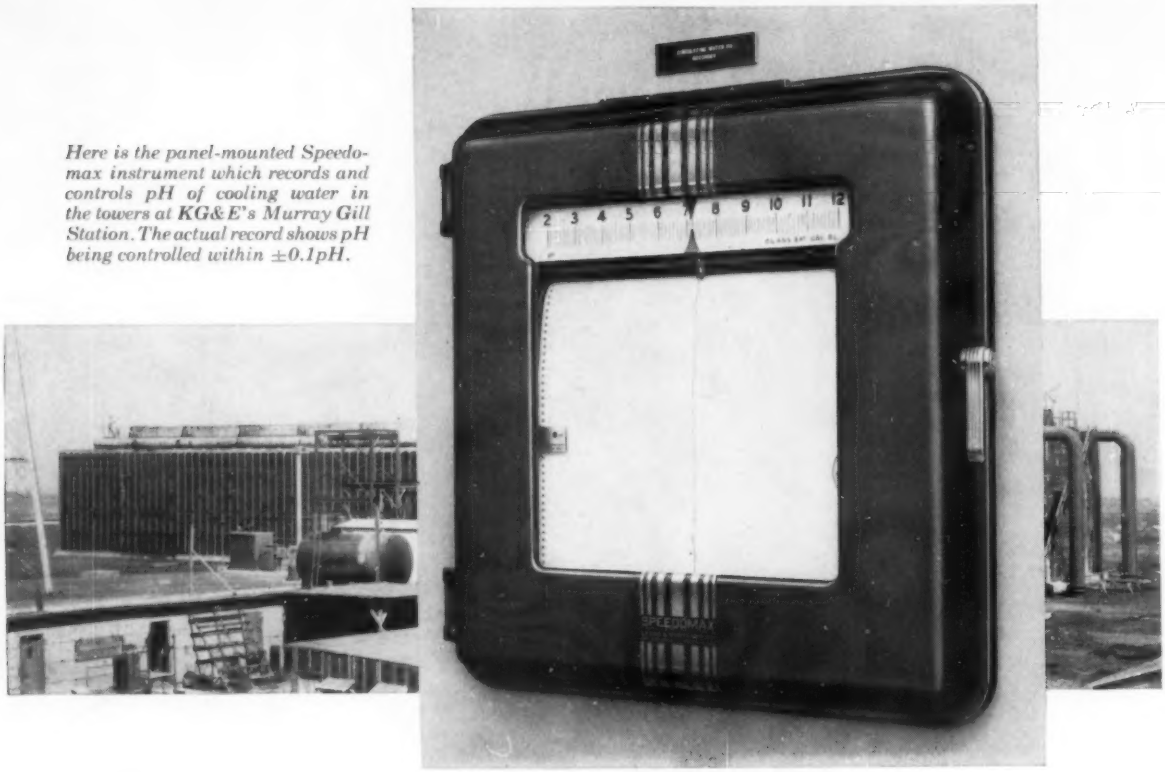
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

NOVEMBER
1954 • 50¢

How Ford tackles air pollution • 73

Here is the panel-mounted Speedomax instrument which records and controls pH of cooling water in the towers at KG&E's Murray Gill Station. The actual record shows pH being controlled within ±0.1pH.



pH is no problem

IN THIS COOLING TOWER

The once troublesome problem of effectively controlling the pH of cooling tower water has been solved in the towers at the Murray Gill and Ripley Stations of Kansas Gas and Electric Company.

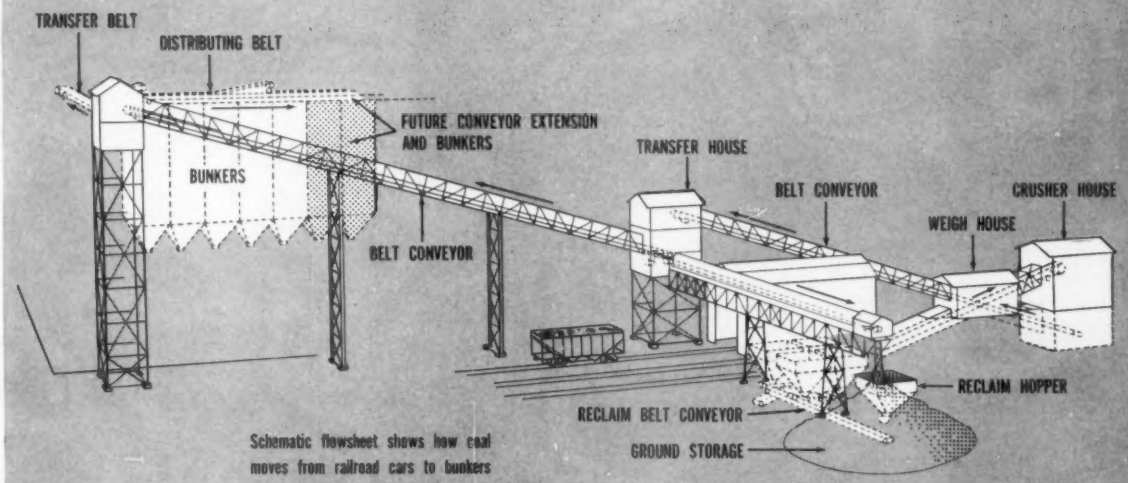
Various other control arrangements, on similar tower systems, have been tried . . . with varying degrees of success. But the present system at KG&E demonstrates that, with the application of L&N's Controllability Analysis and practical engineering principles, a cooling tower system can work *for*, rather than *against*, full-function control of pH.

The benefits of effective pH control are readily apparent at KG&E. According to a report from the company's Production Department, they include "conserving large amounts of make-up water, wood protection, prevention of carbonate scale, and more effective slime control." The report adds that "automatic pH control at both plants has been effective and satisfactory."

We'll be glad to discuss your cooling tower pH control questions with you. Write for Process Data Sheet 700(1) which explains "L&N pH Control of Cooling Tower Water." With it, you'll receive a Controllability Analysis Questionnaire which will help us to analyze the controllability factors of your towers. Fill out the Questionnaire and return it, without obligation, to Leeds & Northrup Co., 4910 Stenton Ave., Philadelphia 44, Pa.

LEEDS *instruments* **NORTHRUP** *automatic controls • furnaces*

One of nation's most efficient stations moves coal on LINK-BELT conveyors



Schematic flowsheet shows how coal moves from railroad cars to bunkers at West Springfield Station of Western Massachusetts Electric Co.

Simple, flexible system designed for future expansion

THIS New England station's heat rate places it within the top group of the most economical in the U. S. Typical of this high efficiency is the Link-Belt coal handling system that is designed to carry twice the present 250 tph without a change in equipment. And, just as Link-Belt engineers worked hand-in-hand with Stone & Webster and the power company's staff, so they can help you get the finest in modern coal handling. Get in touch with your nearest Link-Belt office for a copy of Book 2410 that shows the latest layouts and equipment for power plants, large and small.

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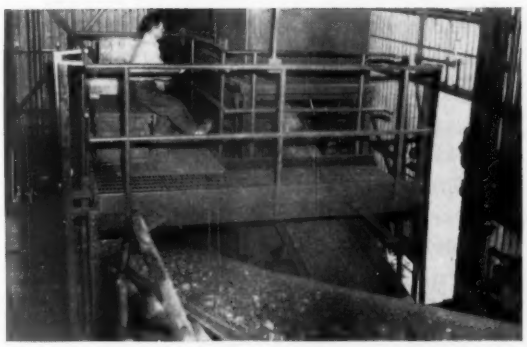
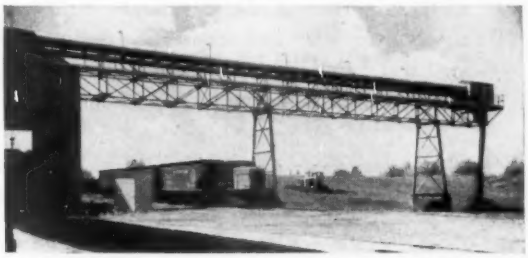
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13.595



Belt conveyor in foreground feeds crushers. Crushed coal goes to bunkers or to reserve storage on conveyor in background.

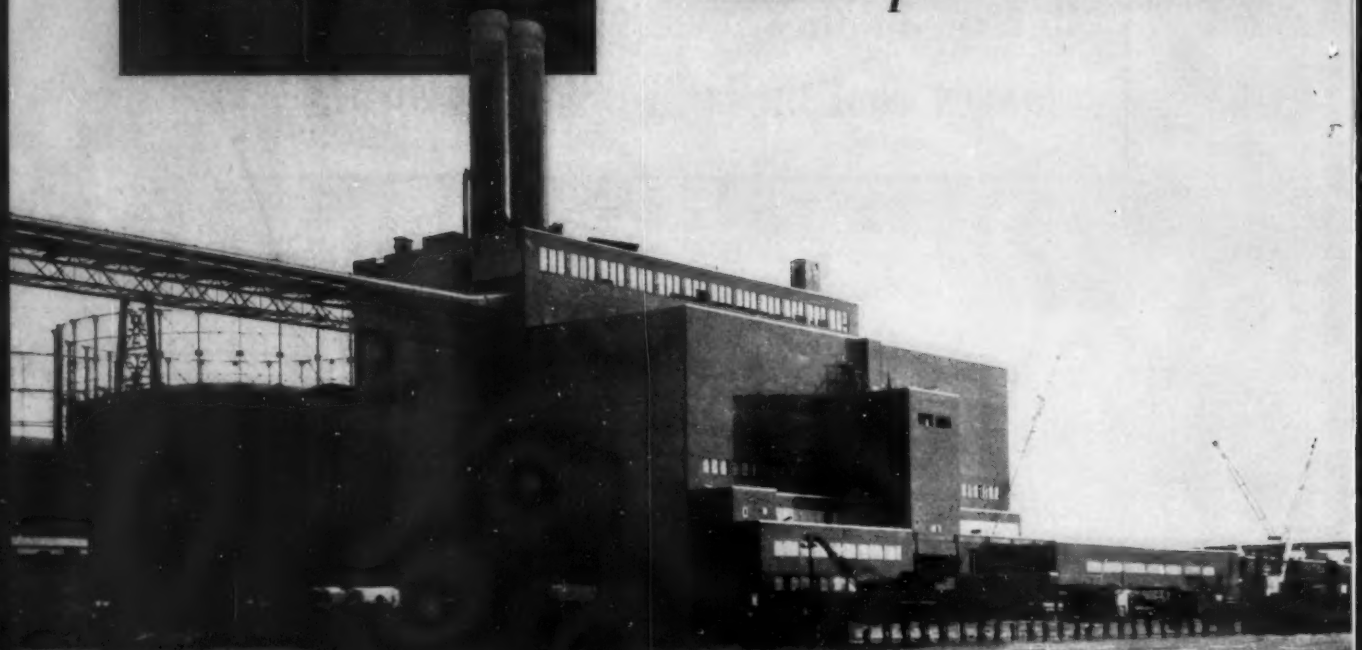


Stocking-out conveyor is one of seven Link-Belt belt conveyors. Coal is weighed on its way to bunkers and in and out of storage.

DE LAVAL

BARREL TYPE
BOILER FEED PUMP

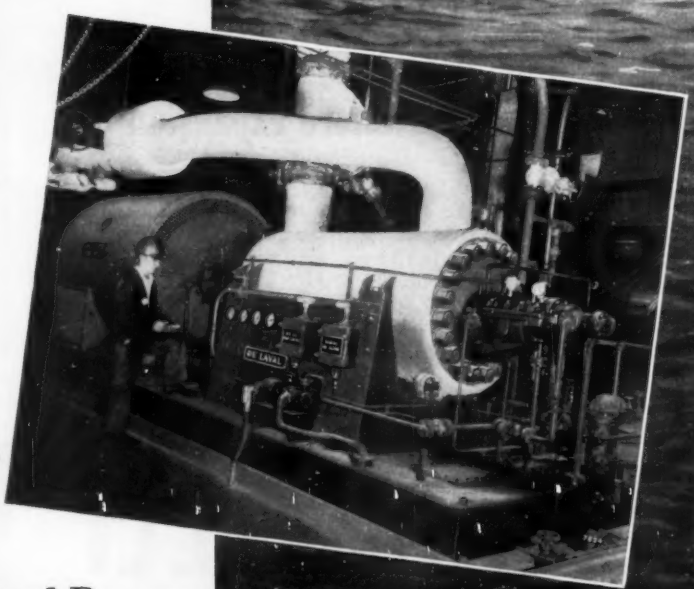
in new Con Edison *Astoria power station*



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.

The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches.

De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.



DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL 288

Power

NOVEMBER 1954 • VOLUME 98 NUMBER 11

ENGINEERING AND MANAGEMENT

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POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

DUST COLLECTORS are an ever more familiar part of the industrial power scene, as the importance of preventing air pollution becomes generally recognized. To a community-minded organization like Ford Motor Company, dust collection naturally formed a major phase of their recent power modernization. The giant cone-filter-type units shown in the cover photo, built by Green Fuel Economizer Company, serve not only the three new 600,000-lb-per-hr pulverized-coal-fired steam generators, but existing units as well.

Our report on Ford's power-plant rehabilitation started in September, with an engineering description of the new steam generators. This month, pp 73-77, you get the story on dust collection and ash handling. A third article will round out the picture with a discussion of the boiler-feed system and water-treatment methods.

Next month . . .

■ December's special report, unlike any other in POWER's history, is designed to be passed along. You'll find it interesting, we're sure, but it's really written for your top management and we're making it easy for you to put it in their hands.

It graphically explains the power services, demonstrates their profit possibilities, paves the way for acceptance of your dollar-saving ideas. Watch for it and put it to work!

■ How would you find a staff for a brand-new plant in an area where no trained men are available? That's a tough problem, but K M White solved it, as he tells in an upcoming story.

■ Want an economical way to set up for easy electrical trouble shooting, production testing, etc? Read how socket meters will do the trick for you as they did in one new plant.

. . . and future months

■ You'll be as surprised as we were when you see how many kinds of packing there are to solve special sealing problems. You'll find them all described, with down-to-earth dope on application, in Steve Elonka's forthcoming practical manual on Packing.

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THIS BATTERY of gas engines in a Texas plant (name on request) has been exclusively lubricated with *Texaco Ursa Oil P* for many years. Efficiency has been outstanding—rings, bearings and cylinder liners in A-1 condition, parts life notably long, maintenance costs low. For similar benefits, use one of the *Texaco Ursa Oil* series.

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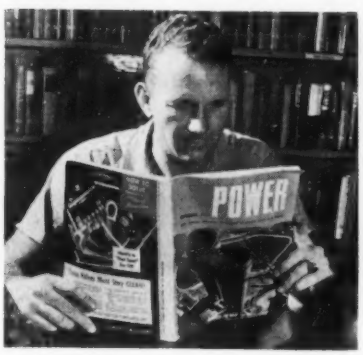


PICTURE PUZZLE

We're used to thinking of the POWER family as being made up of some 45,000 paid subscribers and about 162,000 associates of theirs who read "pass-along" copies. The picture above reminds us of still another branch of the family—the men who read POWER in libraries of various kinds.

There's an interesting story behind this photo. Not long ago, one of our staffers

(*Continued on page* 206)

...lines and bylines

L F O'Reilly

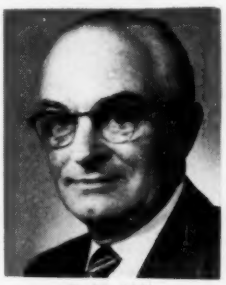
FORD'S OUT FRONT with Leo O'Reilly (Mike) as construction project engineer of power plants. Erection of ash-handling and air-pollution control equipment (see p 73) is but one of several major projects he helps supervise.

Hailing from Kalamazoo, Michigan, Mike attended University of Michigan two years, finishing up at Detroit Engineering College in 1927 with a BME degree.

Detroit Edison Company put his engineering talents to work in 1926, starting him on the board as a piping detailer. Recognition soon followed. Advancing to powerhouse designer, he completed designs on three Detroit Edison power plants.

He was commissioned as naval lieutenant in 1942, and spent the war years supervising repair and contract work at naval shipyards. With present rank of commander in the naval reserve, he commands a reserve battalion in Detroit.

Mike joined Ford's staff in 1946 as project engineer and has been doing a first-rate job ever since.

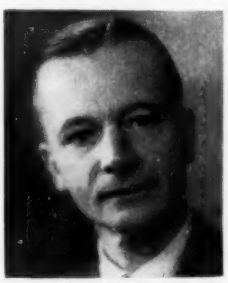

R H Mills

WE'RE A 2-FORD FAMILY this month with co-author Russell Mills pitching in to help tell us how Ford is solving its air-pollution problems.

Mills, mechanical engineer in the plant engineering office, has been with Ford since 1932, when he started as an air-conditioning engineer. Responsibilities have multiplied over the years and he now heads up all design of equipment for heating, air conditioning, and dust control and collection.

A native of Ann Arbor, Michigan, Russ attended his home town's U of Michigan. After receiving his BSME in 1915, he joined Ingersoll-Rand's staff at Painted Post, N. Y., eventually taking over as I-R's Ohio sales engineer. From 1921 to 1923 he was manufacturer's agent for power, heating, ventilating and air-conditioning equipment.

During World War II, Russ Mills' versatile skills qualified him for aircraft-engine engineering at Ford.


F H Reynst

PULSATING COMBUSTION is both a hobby and a professional specialty for F H Reynst. As the story goes, he accidentally threw a burning match into a spirits burner. Only a small amount of fuel remained and the burner started to pulsate. He's been building pulsating burners ever since.

Widely traveled, Reynst was born in Bandoeng, Java, the son of a Dutch tea grower. He can talk endlessly of the experiences of his early youth at his father's tea plantation and tea factory, where he first tinkered with machinery.

Then came high-school years in Holland, and college at Zurich, Switzerland. But developing a workable pulsating burner occupied most of his spare time—and money. During the depression and war years, Reynst managed to interest the Swiss firm of Sulzer and a Germany company—MAN—in his ideas.

Revival of interest in pulse-jet burners during and after the war gave him the opportunity to build pulsating burners in France. A leading European boiler firm is now studying his work.

4 B&W BOILERS AT P·G·and E·'s

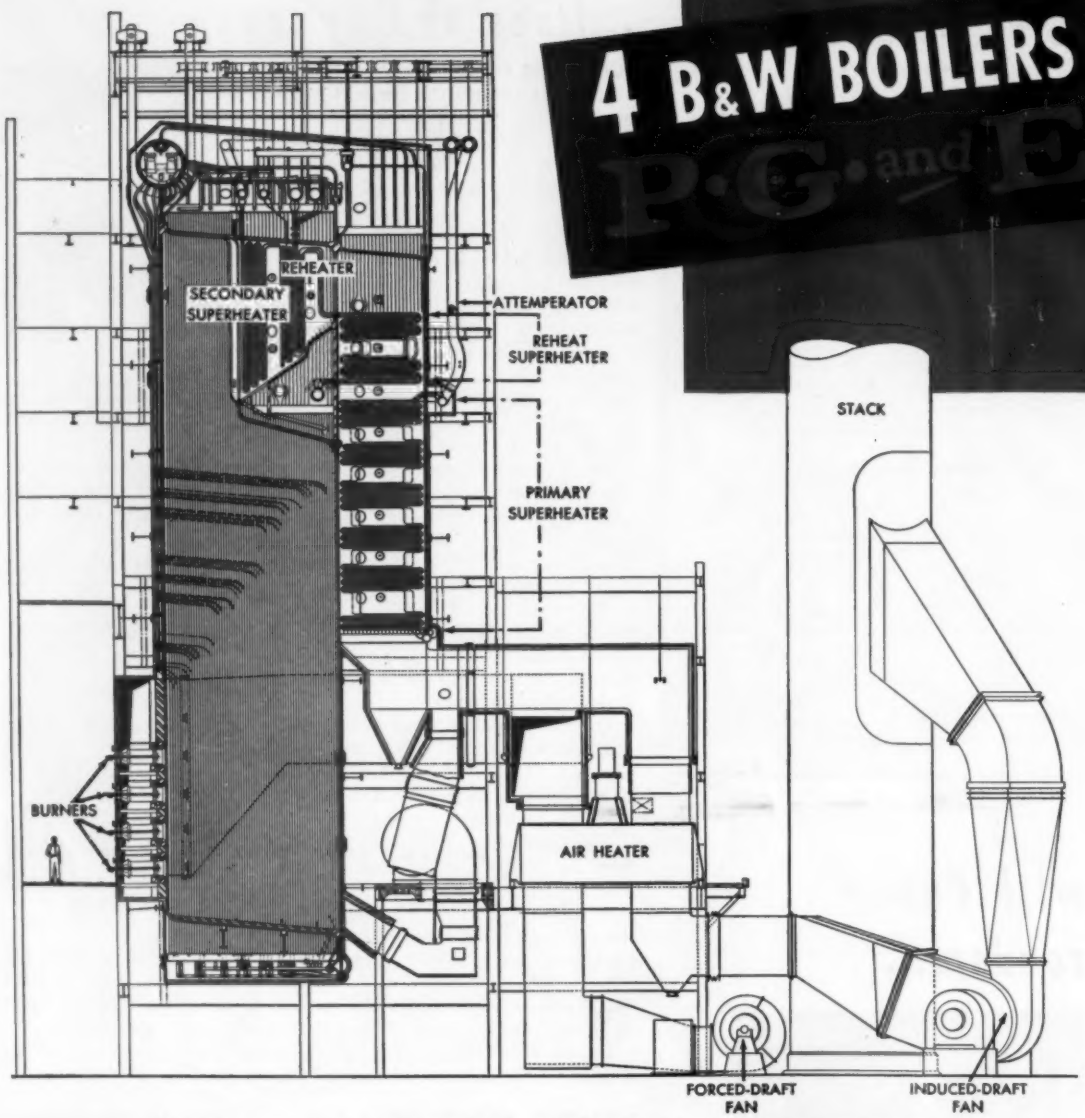
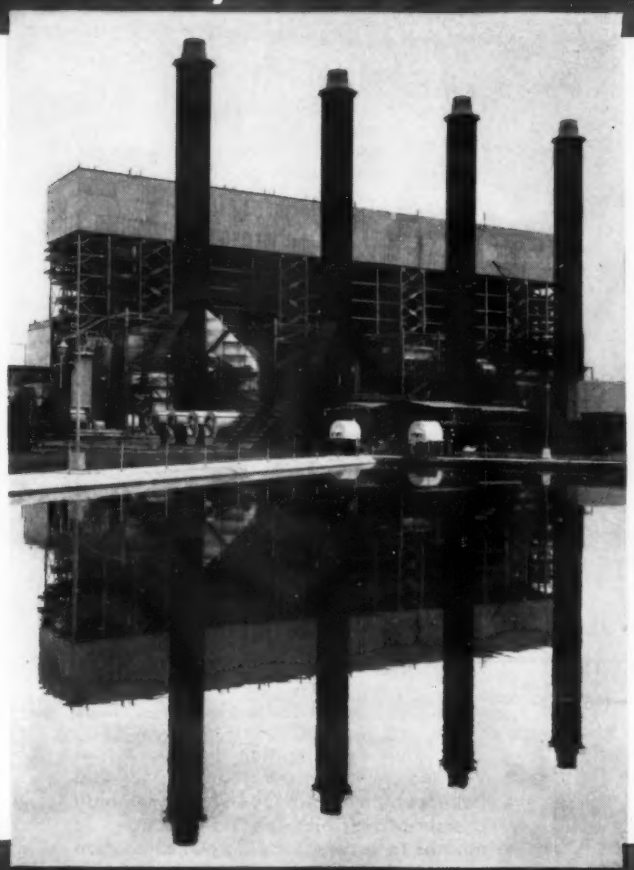


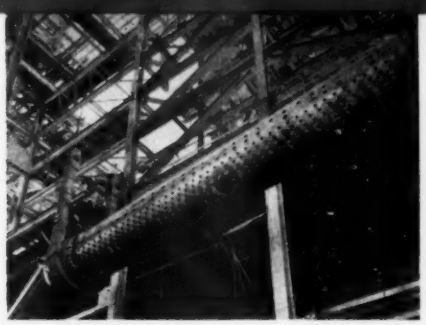
Diagram of one of four B&W Radiant Reheat Boilers with natural circulation. Designed for outdoor installation, each unit has a steam capacity of 1,080,000 lb per hr. Design pressure is 2050 psi and steam at 1850 psi will be superheated to 1000 F, with reheat to 1000 F.

With the emphasis on low initial cost, high efficiency, and reliability of operation, Pacific Gas and Electric Company has built its new Pittsburg Plant to keep ahead of the increasing demands of this heavily industrialized California area. With a generating capacity of 600,000 kw, it is the largest steam-electric generating station yet built west of the Mississippi River and is indicative of the far-sighted planning of this utility.

The installation of four B&W Radiant Reheat Boilers will give the big Pittsburg Plant a steam capacity of over 4,000,000 lb per hr. Designed with B&W Cyclone Steam Separators for natural circulation, each unit is equipped to burn oil and natural gas with provision for later conversion to coal if this becomes desirable.

new Pittsburg Plant help generate 600,000 more kilowatts





One of the huge steam drums being jockeyed into place. Each drum weighs more than 150 tons and is 56 feet long.

P. G. and E.'s new modern Pittsburg Plant is the largest steam-electric generating station in the West. Everything except the control room, firing aisles and ends of turbines is outdoors. Bechtel Corp., engineers.

Front of boiler furnace wall under construction. Openings are for the 16 burners with which each unit is equipped.

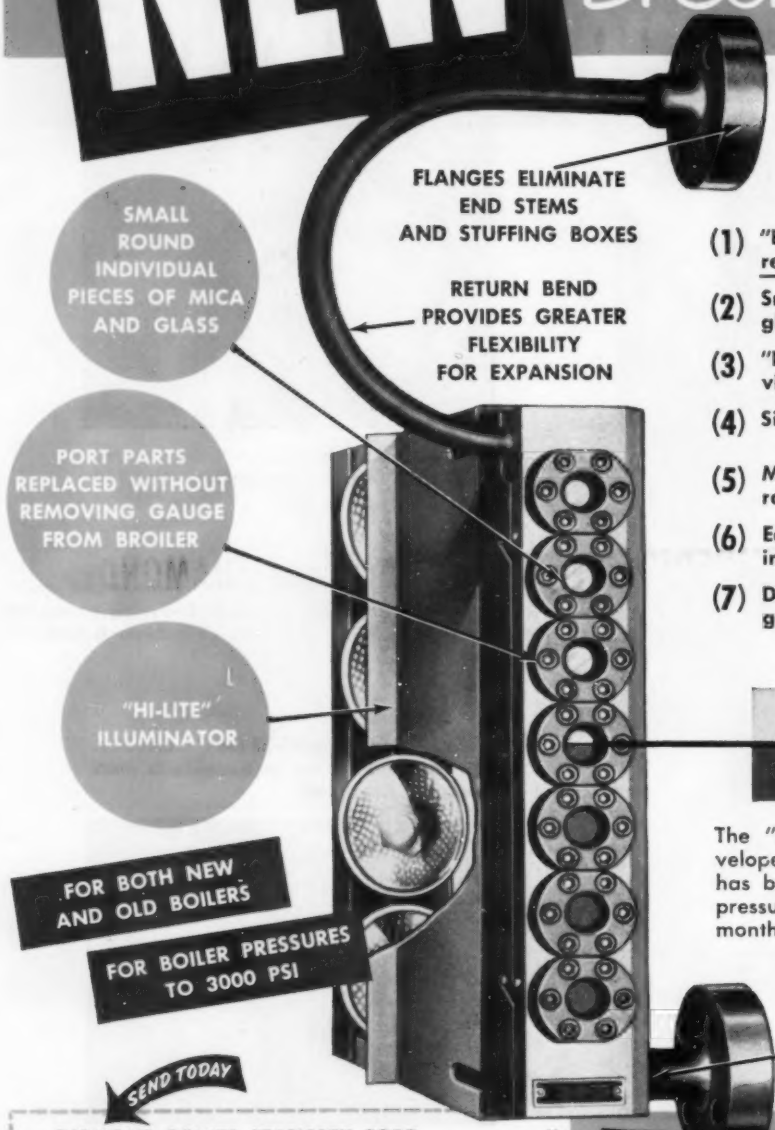
This outstanding station represents a combination of new engineering trends and sound design practices. The B&W steam generators at the Pittsburg Plant are among the most modern of their type; one more example of the unending cooperative efforts of power company and B&W engineers working together for almost a century to attain ever-higher peaks of efficiency in power generation.

BABCOCK & WILCOX

BOILER DIVISION

G-685

NEW DIAMOND "MULTI-PORT"® Bi-Color Gauge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The "Multi-Port" gauge has been developed over a four-year period and has been in continuous successful high pressure operation for more than 18 months in several leading central station plants. For additional information, write for new Bulletin 1174 . . . use the coupon below.

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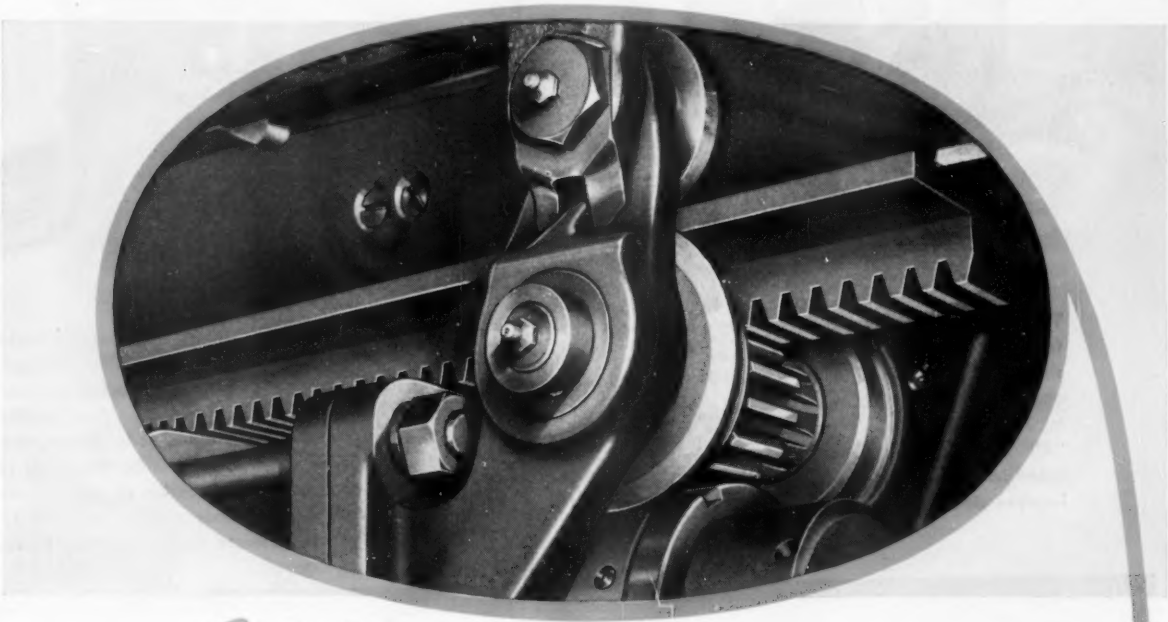

Another Reason

for the **SUPERIOR PERFORMANCE** of DIAMOND Model IK LONG TRAVEL RETRACTING BLOWERS

The lance tube of the Diamond Model IK Long Retracting Blower is propelled into the furnace by the carriage which is driven by a rugged pinion gear which engages a heavy rack. Gearing will stall lance in event of motor drive failure during blowing. This represents the ultimate in safety and reliability.

This is only one of several reasons for the superior performance of the Model IK. Others are the single motor drive (one motor simultaneously propels the carriage and rotates the lance) . . . mechanically operated poppet valve which provides simple, positive and accurate control of blowing medium (air or steam) . . . integral adjustable pressure control.

Advanced engineering features such as these, plus reliability proved over the years, are important reasons why the great majority of engineers prefer Diamond Blowers.

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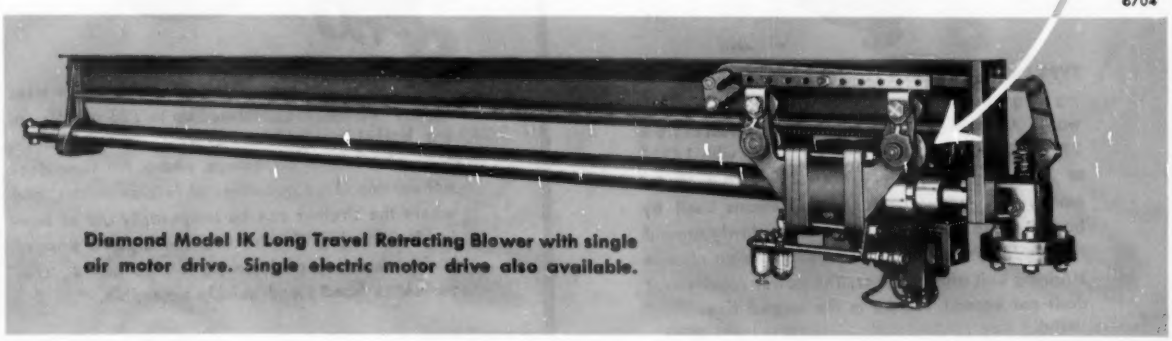
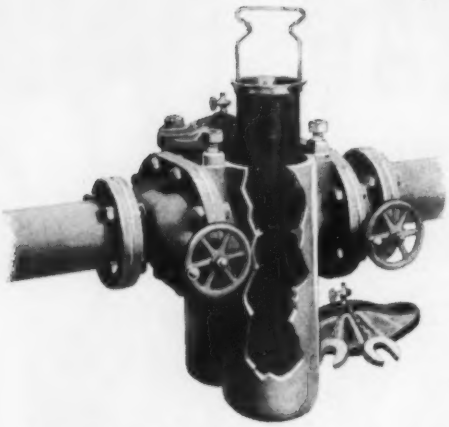
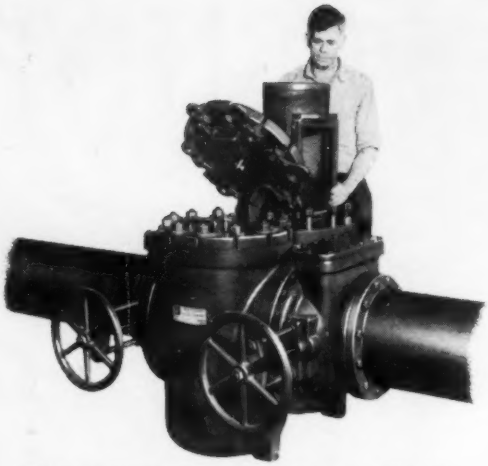


Diamond Model IK Long Travel Retracting Blower with single air motor drive. Single electric motor drive also available.



TYPE "V" TWIN STRAINER — Specially designed for lube oil, fuel oil, and viscous liquids. Available sizes 1" to 8" for 125, and 1½" to 10" for 300 and 500 psi. Straining baskets available with 1/64" to 3/16" mesh. Twin operation similar to Type "A" Strainer. Extra large straining baskets and unrestricted fluid passages insure maximum time between cleanings.

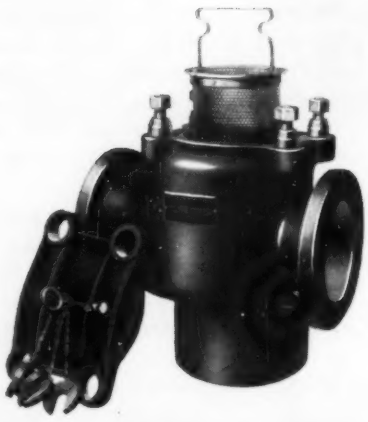


TYPE "A" TWIN STRAINER — For water and other liquids . . . available sizes 4" to 24" for 125 psi — 4" to 12" for 250 psi. Straining baskets available with 1/32" to 3/8" mesh. The twin feature offers two straining chambers in one body. By operating two valves, either chamber can be closed for removing and cleaning the basket at your convenience. With one chamber always available for service, you are assured continuous clear liquids.

DESIGNED TO GET LIQUIDS

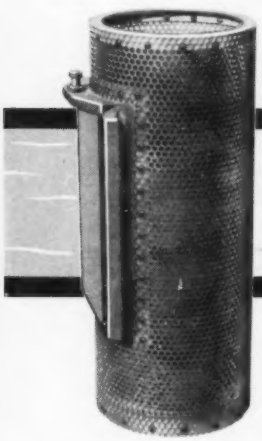
TYPE "K" SELF-CLEANING STRAINER — For removing large amounts of dirt and foreign matter from water. Available sizes 4" to 24", for pressures from 25 to 125 psi. Straining units available with 1/32" to 3/8" mesh. Can be furnished with a-c or d-c motor. This strainer continuously cleans itself by back-flushing as sealing boxes move slowly around the inside of the cage, successively sealing off one straining unit after another. The power requirement does not exceed 1/2 hp in the largest size.

A4-2



TYPE "F" SINGLE STRAINER — Available in sizes from 2" to 24" for pressures up to 125 psi. Straining basket available with 1/32" to 3/8" mesh. May be used to advantage where the flow does not contain large quantities of foreign matter, and where the strainer can be temporarily out of service for cleaning. Construction consists of a flanged body containing a single perforated basket, convenient to handle and quickly accessible.

ELLIOTT STRAINERS



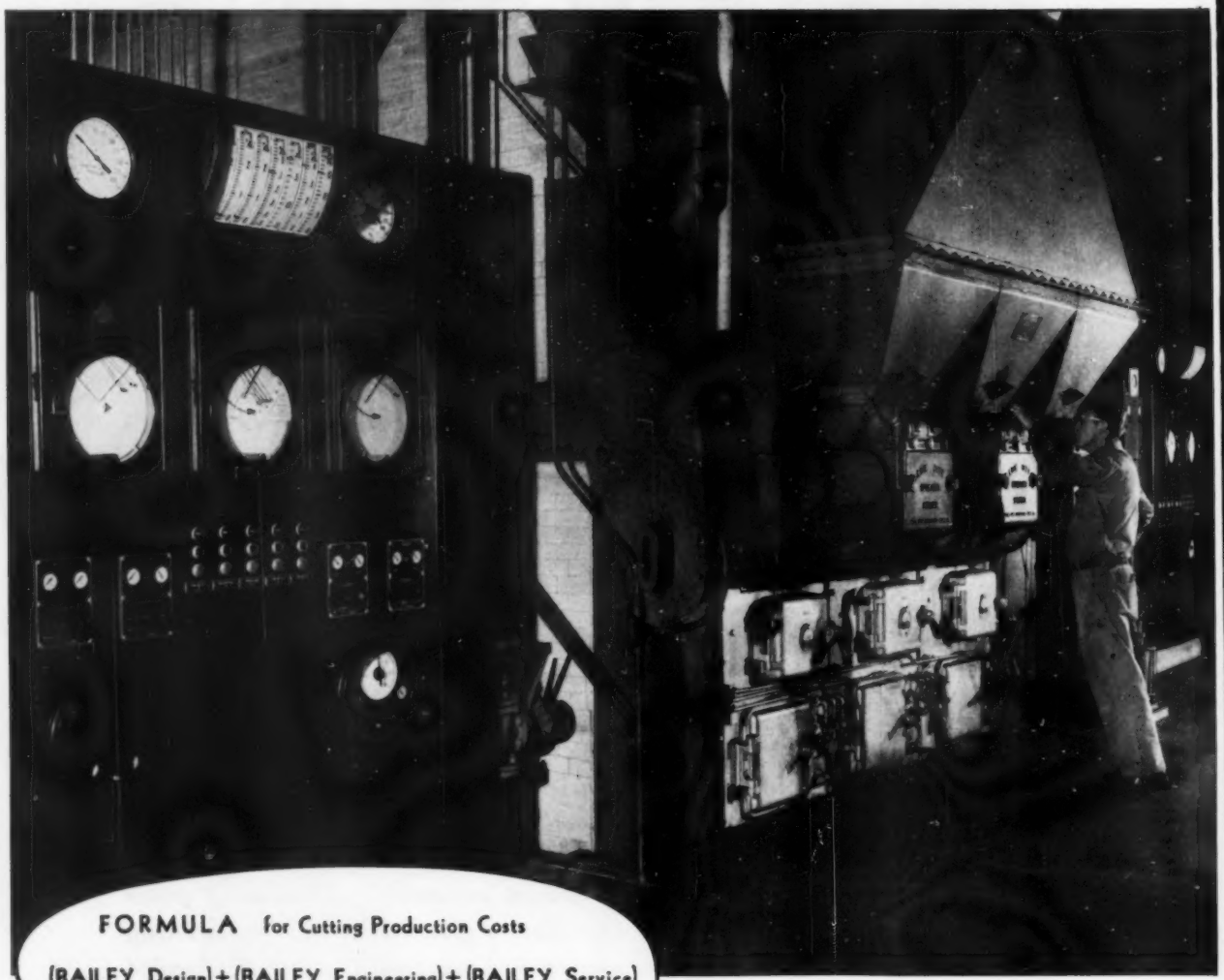
"TROUBLE-FREE" CLEAN

THERE'S NO CHANCE of foreign matter gumming up your costly liquid-handling equipment when Elliott strainers are on the job. They have proven an excellent method of removing objectional solids from water, fuel and lubricating oil, gasoline, and in fact any strainable liquid. Backed by fifty years of Elliott design and construction experience, these present-day strainers are servicing thousands of power and industrial plants everywhere. The line offers a great variety of types including single, twin, and self-cleaning strainers, covering pipe sizes from 1" to 24". For detailed information on any or all of these strainers, call your local Elliott field engineer or write Elliott Company, Accessories Dept., Jeannette, Pa.

ELLIOTT Company

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS

How to Cut



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

At the heating plant of Lincoln Electric Co., Euclid, Ohio Bailey Control helps to cut operating costs by:

1. Controlling the rate of combustion in two spreader stoker-fired hot water boilers to maintain the desired temperature of outlet water.

2. Controlling fuel-air ratio at each boiler by means of a unique Btu-Air Flow meter which maintains most economical use of fuel.

3. Controlling quantity of water by-passed around boilers, thus tempering water supplied for heating in accordance with changes in outside temperature.

Operating Cost

★ When your plant is operating at peak efficiency, unit production costs are low. But outages of any kind upset the balance. As efficiency drops, and/or outages occur, overhead costs impose an increasing burden—bring on dollar losses that can't be recovered.

That's why you can use Bailey Co-ordinated Control Systems to advantage. Here are three reasons why Bailey systems are the best you can buy:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control *systems*.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

Bailey Meter Company's sales service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

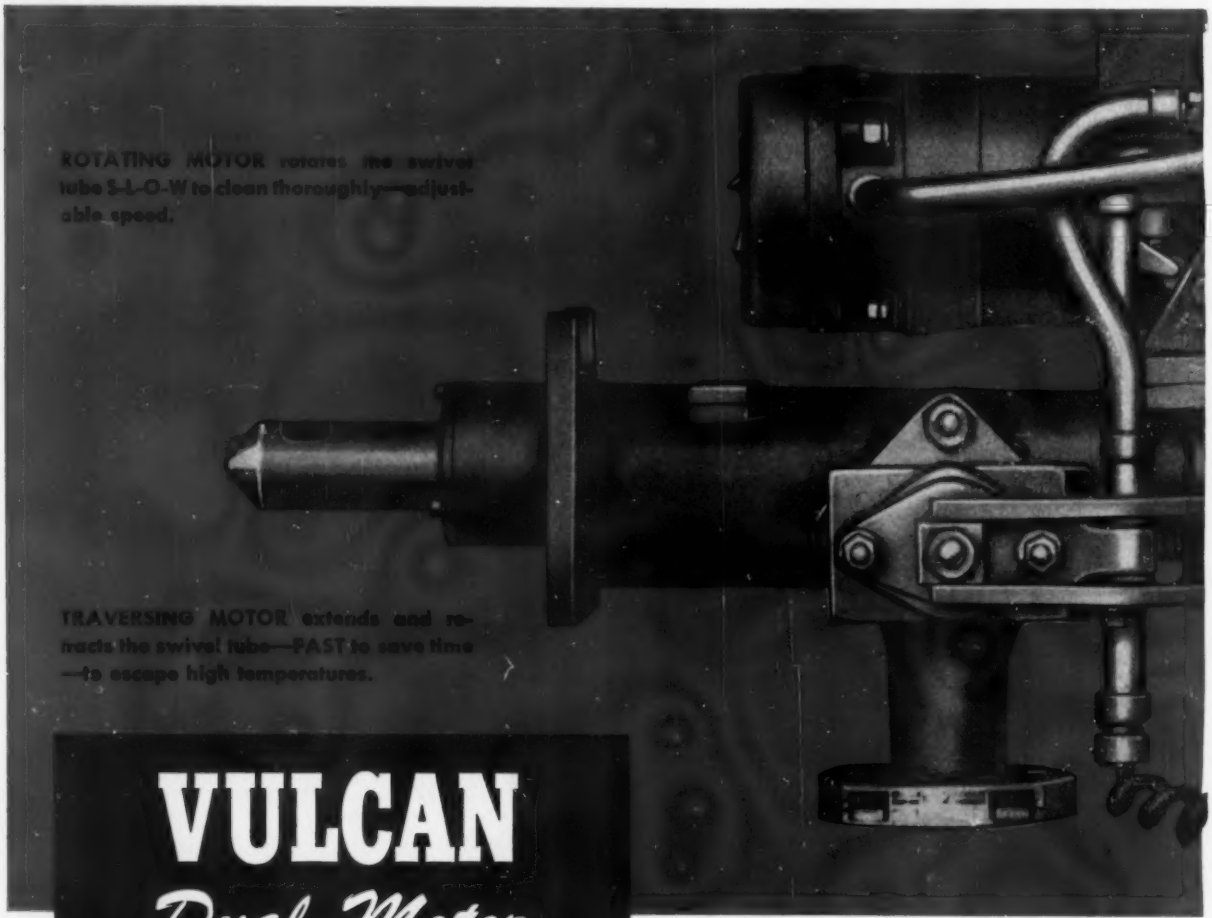
For lower operating cost—for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-119A-2

BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

How to STOP


ROTATING MOTOR rotates the swivel tube S-L-O-W to clean thoroughly—adjustable speed.
TRAVERSING MOTOR extends and retracts the swivel tube—FAST to save time—to escape high temperatures.

VULCAN
Dual-Motor Wall Deslaggers

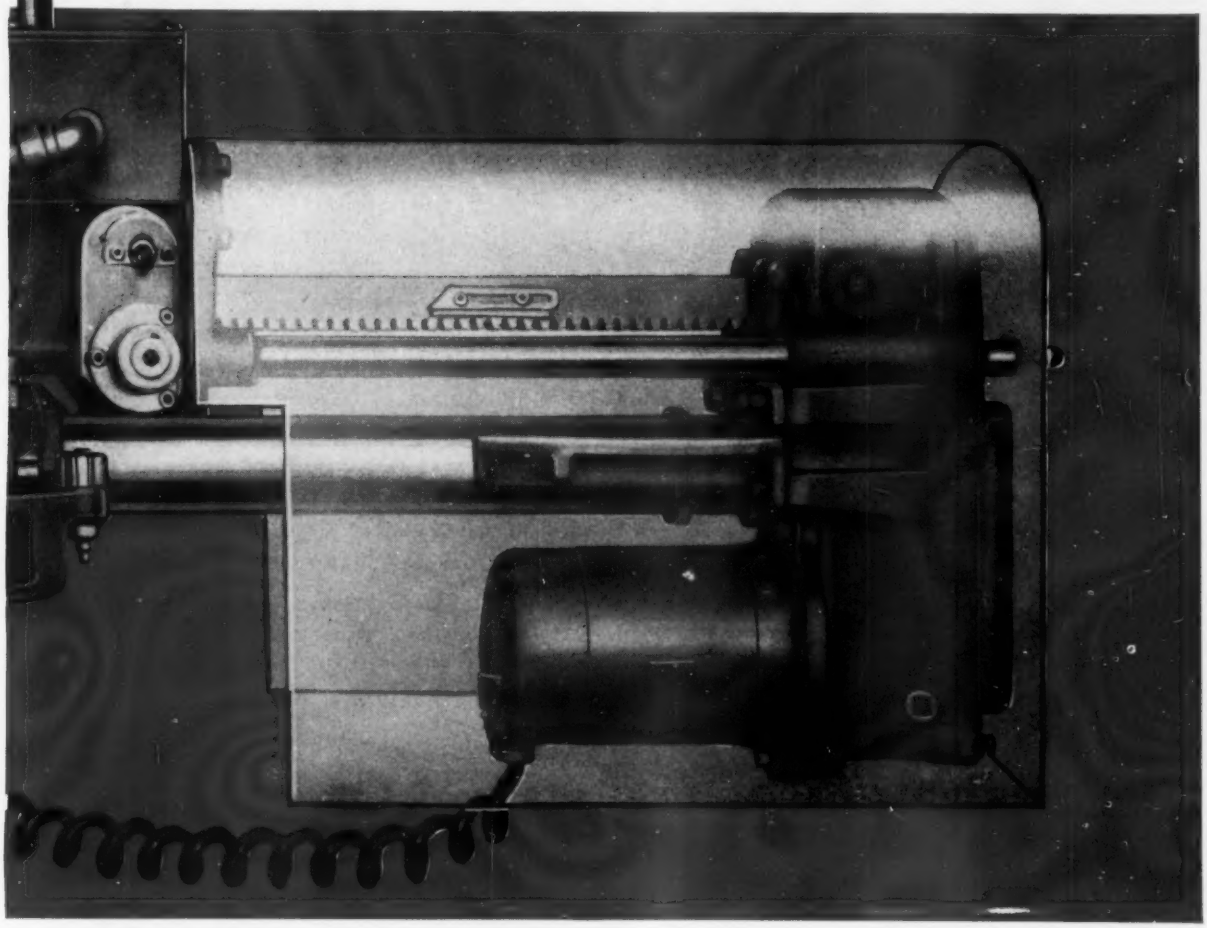
With direct-acting valve
Clean BETTER and FASTER

KEEP slag and sintered dust from upsetting heat-transfer capacity and superheat or reheat control. Stop their build-up—quickly and effectively—with the high-power mass blowing and fast action of Vulcan Wall Deslaggers.

Thanks to dual-motor drive—electric or air, electric shown—a Vulcan Deslagger

VULCAN *Automatic*

SLAG BUILD-UP



extends into the boiler, cleans and retracts from the high-temperature zone—all in 76 seconds. The cycle can be repeated often, if needed to control deposits.

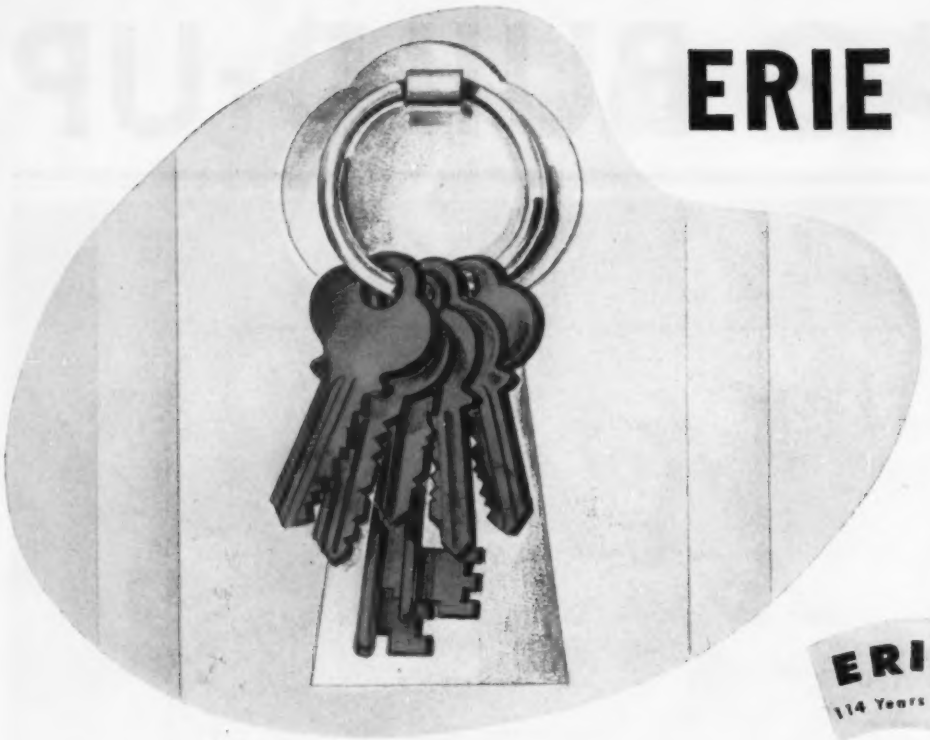
Steam, air or water—or any combination of them—may be used as the blowing medium without change in equipment. The blowing or cleaning arc can be any angle up to a full 360 degrees.

The story is told in detail by new Bulletin 1016. Write for it.

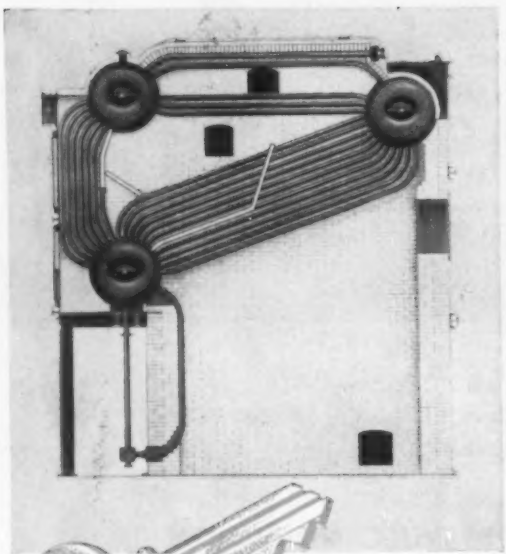
COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

Soot BLOWERS

ERIE CITY

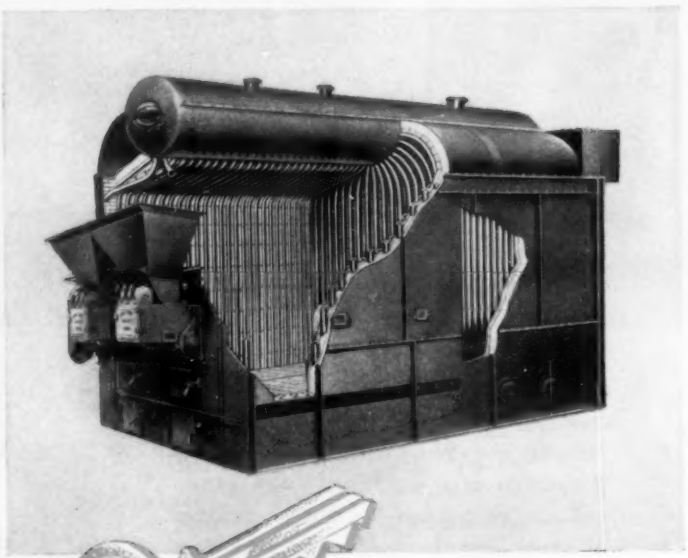


ERIE CITY
114 Years in Steam Generation



TYPE "C"

Three drum boiler—larger water and steam holding capacity; internal baffles extremely simple; unique method of steam take-off eliminates moisture carryover while producing 8° to 14° F. superheat.



TYPE "VL"

Two drum boiler — designed for shop assembly to eliminate much of the costly field brickwork. Completely water cooled furnace keeps maintenance to a minimum. Headers are accessible through handholes from outside of the setting.

has a key to the solution of your steam problem—

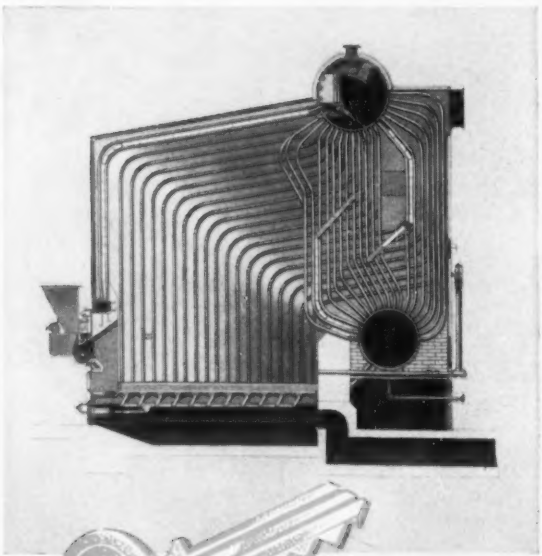
The keys are Erie City's complete line of steam power plant equipment, coupled with sound engineering. Here we show just four of the accepted designs of steam generators which can be adapted to your needs. Each has inherent advantages for large industrial, processing, or institutional steam demands.

Which design should you use? That's where Erie City Engineers apply sound engineering principles — offering you the most economical solution, consistent with high efficiency, and utilizing to the best advantage facilities and space. General Catalog SB-50 illustrates the complete line of products.

You can depend on Erie City for sound engineering

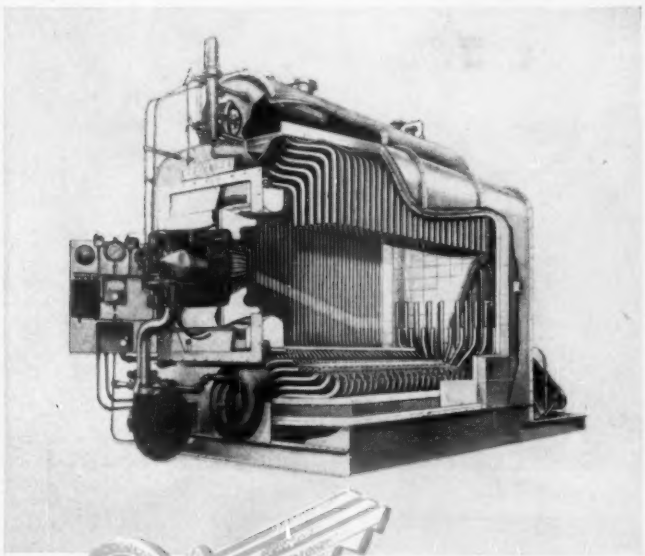
ERIE CITY IRON WORKS • ERIE, PA •

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS



TYPE "VC"

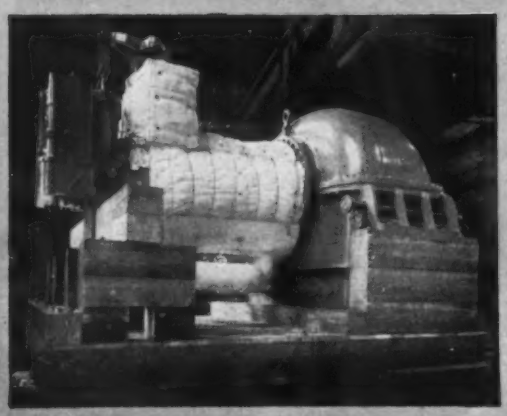
Modern two drum boiler modified from a basic design to include a completely water cooled furnace as an integral part of the main circulation system. This water cooling eliminates heavy refractory linings, reducing installation costs. Contact type steam scrubber assures high quality steam.



TYPE "K"

Package steam generator complete with all combustion and safety controls, burner and fan; mounted, piped and wired on a common base for easy field installation. FACTORY FIRE TESTED using specified fuel and duplicating actual field conditions.

Another

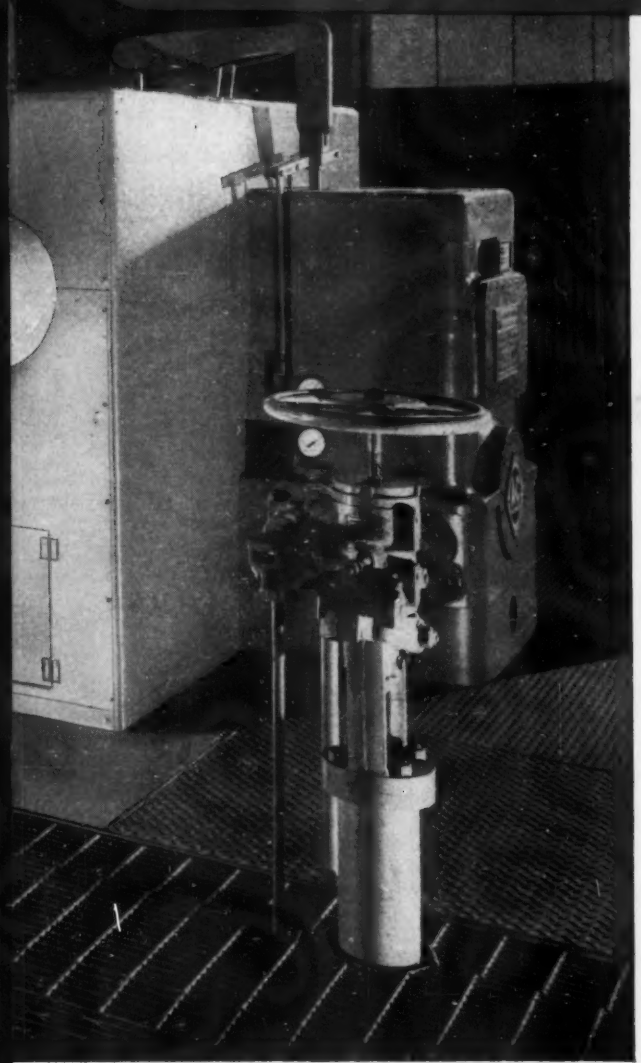


To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

WA-Series

STEAM TURBINE GENERATOR UNIT



Engineered to Meet Requirements of a Modern Power Plant!

HERE'S another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

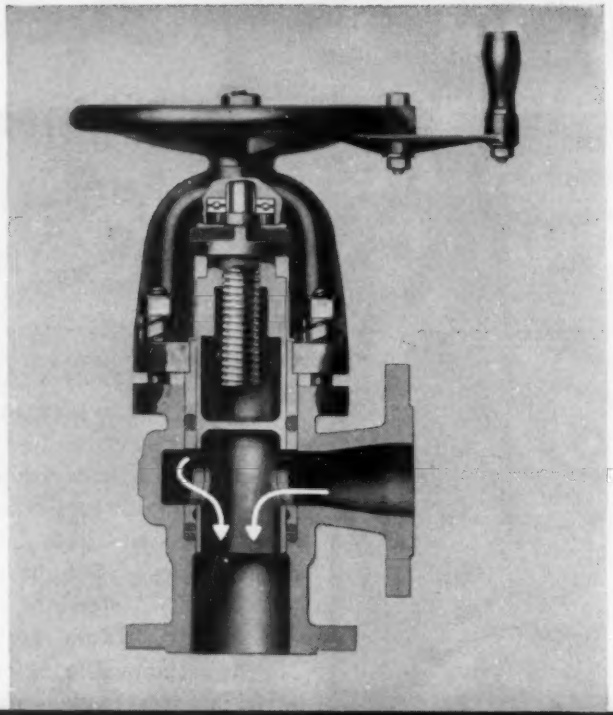
ALLIS-CHALMERS

A-C ALLIS-CHALMERS

These YARWAY VALVE DESIGNS

YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR HIGHER PRESSURES

USED IN OVER 15,000 BOILER PLANTS

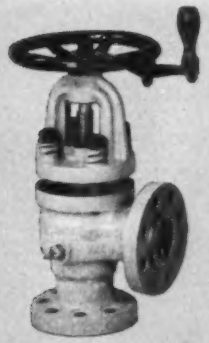
serve every boiler blow-down need

■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

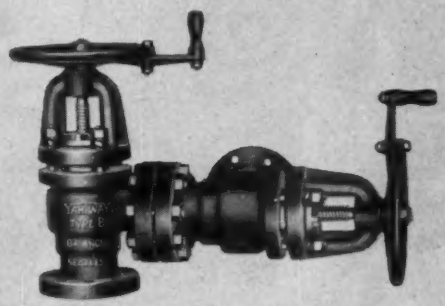
Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

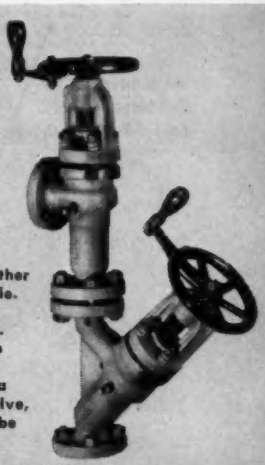
Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.



• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.



• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the sealing valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.

• Yarway Unit Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless sealing valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

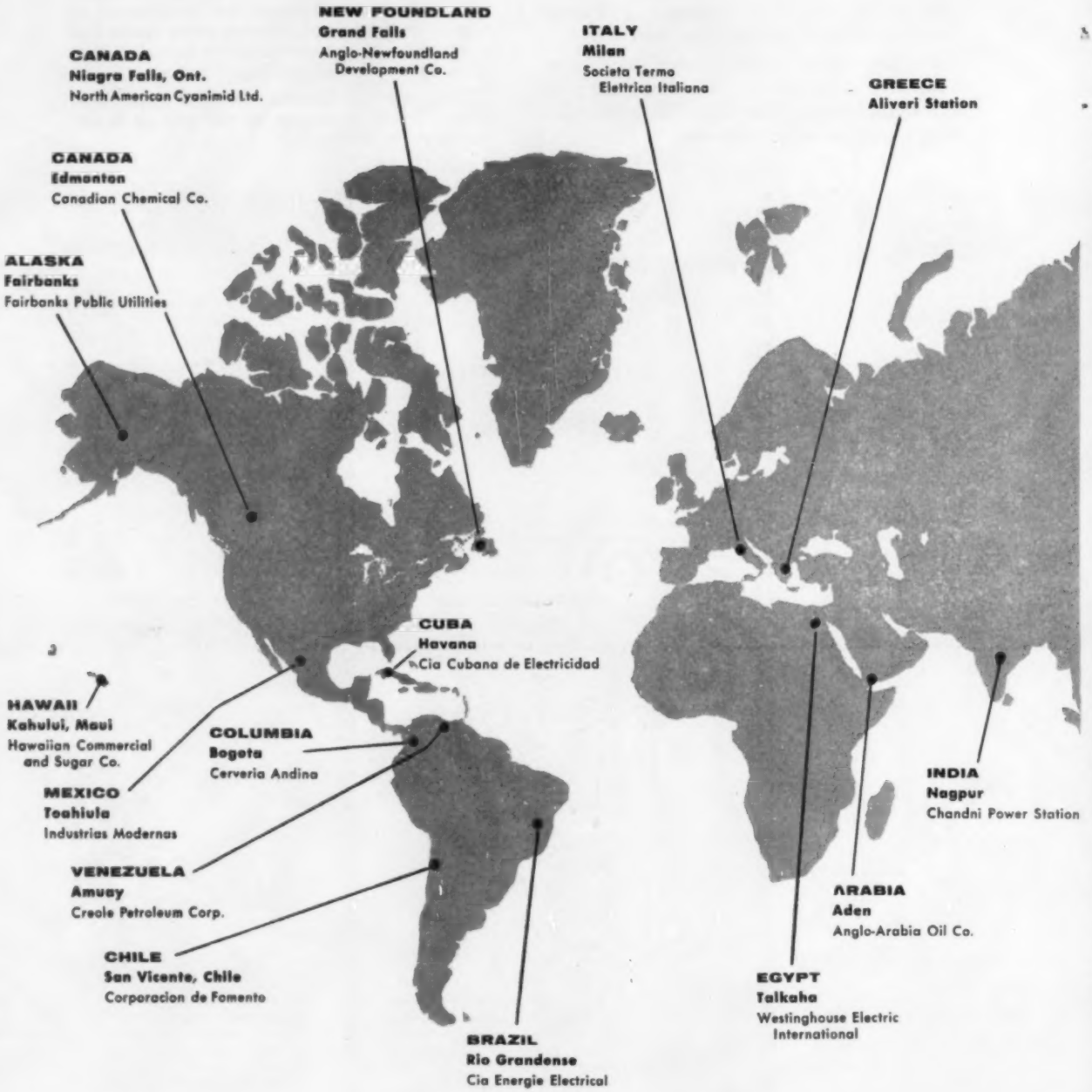
LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

blow-off valves

Choose the Combustion Controls

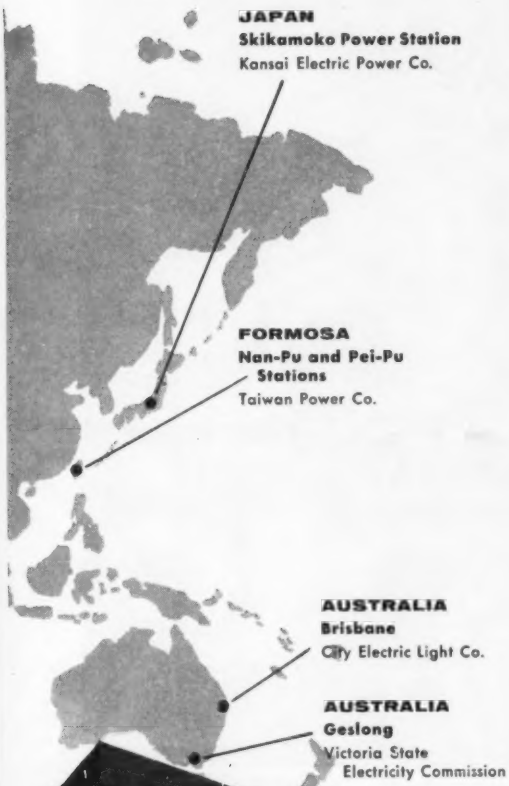


THIS IS ONLY A PARTIAL REPRESENTATION OF POWER PLANTS OUTSIDE OF THE UNITED STATES WHICH RELY ON REPUBLIC CONTROLS.

REPUBLIC FLOW METERS CO.

with a World-Wide Reputation

REPUBLIC *Automatic* COMBUSTION CONTROLS



Combustion efficiency is spelled and pronounced many different ways throughout the world. It's even expressed in two different units — pounds or kilograms of steam produced per unit of fuel consumed. No matter how you spell or measure it, however, its importance is the same to power plants everywhere — in ancient Peru or the distant Philippines.

To get maximum combustion efficiency in power plants all over the world, engineers have specified Republic Controls again and again. With Republic, they know they are getting an extra "plus" in dependability because Republic Controls are ruggedly built to match the high availability of other equipment in the plant.

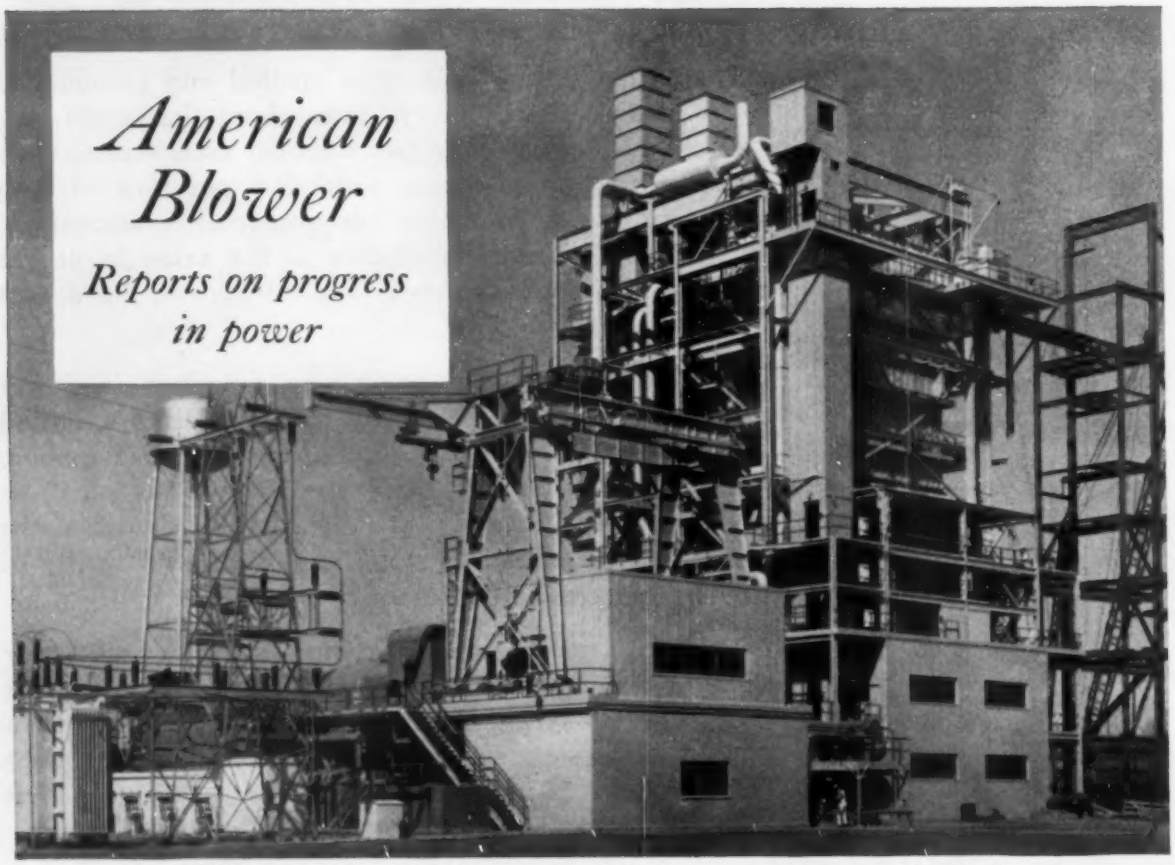
In *your* plant, insure maximum combustion efficiency and dependability by specifying Republic. At your service is an engineering staff with more than 35 years of specialized experience in power plant control to help you design the system that best meets your needs.

REPUBLIC Automatic COMBUSTION CONTROLS

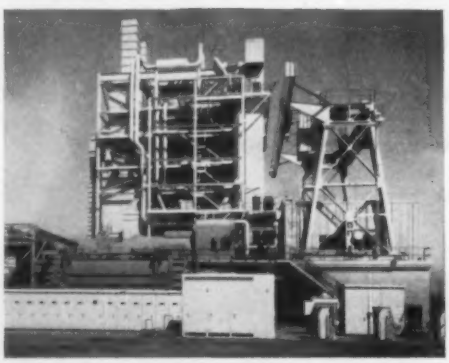
- **For all types and sizes of boilers**
- **For all types of fuel**
- **For all types of firing**
- **For all arrangements of draft**
- **For all load conditions**

2240 Diversey Parkway • Chicago 47, Illinois

Dallas Power & Light Co. Sirocco Fans for Parkdale



DP&L's No. 1 unit at Parkdale Plant has 87,000 kw generating capacity. The No. 2 unit, now under construction (far right) will add an additional 115,000 kw of capacity.



DP&L expansion program will increase capacity 48 per cent in two years

Two 115,000 kilowatt generating units under construction at Dallas Power & Light Company plants would have served all of metropolitan Dallas' electrical needs as late as 1949. One of the two new units is shown at left at Parkdale Plant, and the other is being built at DP&L's Mountain Creek Plant. Together, the new generators will increase the company's capability 48 per cent by the end of 1956. They will help meet peak demands on DP&L's system which have risen at an average rate of 17 per cent each year since 1946.

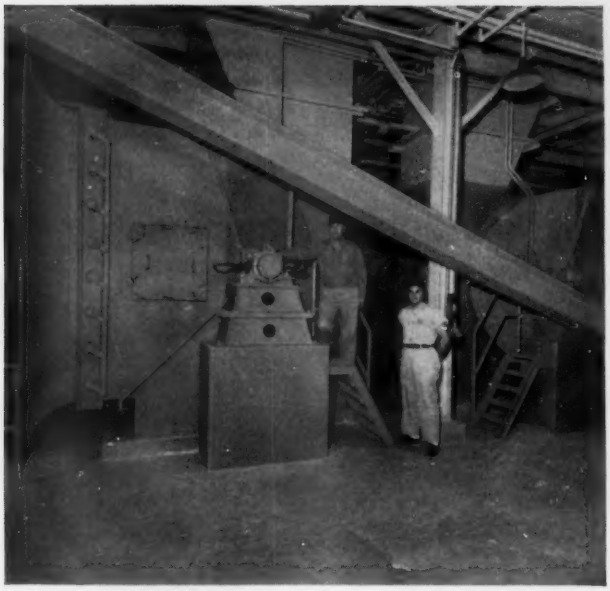
chooses Plant

PARKDALE PLANT, newest of Dallas Power & Light Company's generating stations, is the Company's first station to use a pressure furnace. For its initial unit and for Unit No. 2, which is scheduled for completion early in 1955, Dallas Power & Light Company selected American Blower Sirocco Forced Draft Fans.

American Blower Sirocco Fans have long been favorites with progressive power plant operators throughout the United States and Canada. And for good reasons! Sirocco Fans are extremely quiet in operation; they are dependable; and they are economical to run.

In addition to Mechanical Draft Fans for both forced and induced draft, American Blower manufactures Fly Ash Precipitators, Heavy-duty Steam Coils and Gyrol Fluid Drives, for smooth adjustable speed control of fans and boiler feed pumps.

If you have an air handling problem, or plan to expand or modernize your facilities, let American Blower's wide experience work for you. Contact your nearest American Blower Branch Office or write us direct.



Two American Blower Forced Draft Fans are in operation at the Parkdale Plant. Capacity of each is 123,500 cfm at 100° F at 29" sp. Each fan is driven by an 800-hp motor.

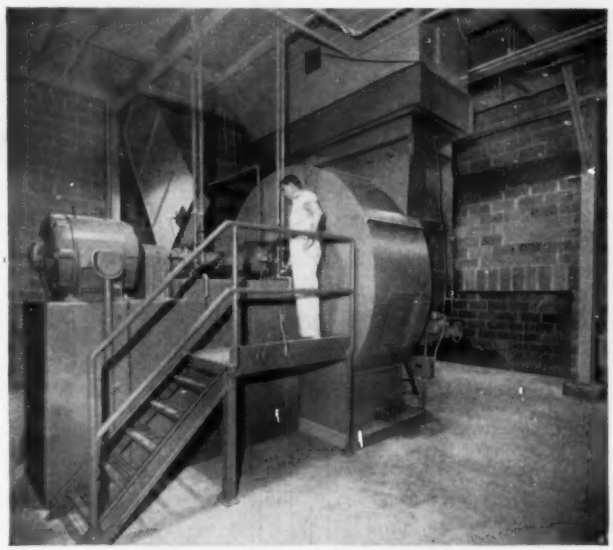


Photo shows an American Blower Recirculating Gas Fan in operation at the Parkdale Plant. Driven by a 100-hp motor, it is rated at 54,000 cfm at 775° F at 6.6" sp.

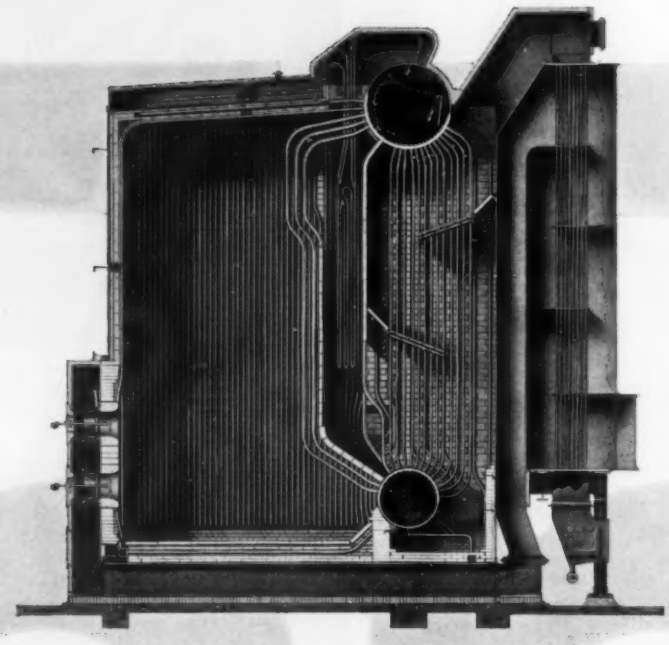
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

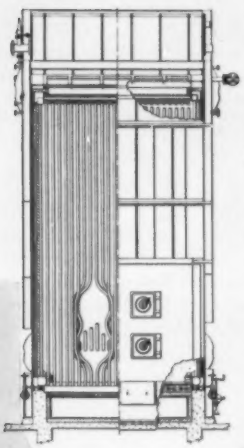
AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

THE VU-55---



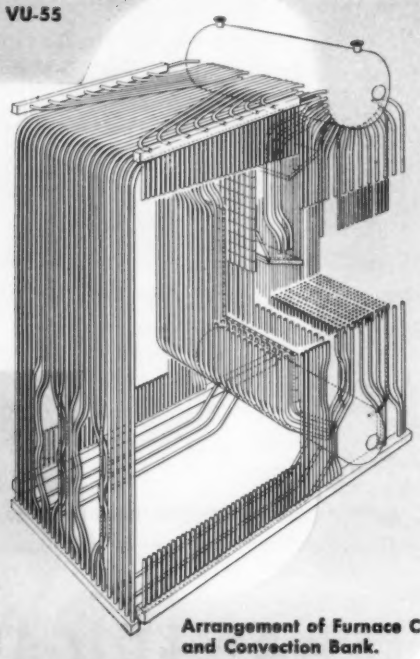
C-E Vertical-Unit Boiler, type VU-55



Front Elevation

SPECIFICATIONS

Sizes—Six sizes ranging from 50,000 to 120,000 lb of steam per hr.
Pressures—250 to 500 psi (all sizes)
Temperatures—as required up to 750 F
Fuels—oil or gas
Heat Recovery—Tubular Air Preheater



Arrangement of Furnace Cooling and Convection Bank.

A NEW MEMBER OF THE VU FAMILY

. . . for steam requirements from 50,000 to 120,000 lb per hr

One of the most important size groups of industrial boilers is that comprising capacities ranging from 50,000 to about 100,000 pounds of steam per hour.

Combustion Engineering has designed a boiler unit especially suited to the modern requirements of that capacity range. It is the Vertical-Unit Boiler, Type VU-55, here illustrated and described.

Developed with the same background of experience and engineering competence that is responsible for the service-proved success of Combustion's VU-family of boilers, the VU-55 offers numerous advantages to anyone whose steam needs fall within its application range. The more important of these advantages are:

ADVANTAGES

FURNACE ARRANGEMENT—The VU-55 is designed specifically for firing with oil or gas fuel. The furnace is high; the burners are set low in the front wall. The resultant long flame travel assures adequate mixing and proper combustion.

SYMMETRICAL DESIGN—Each transverse section through the VU-55 Boiler is the same as every other. Furnace gases flow across the surface of each section in equal amounts and at the same relative temperatures. Each section, therefore, absorbs the same amount of heat—produces the same amount of steam. Expansion of pressure parts is uniform; steam is released evenly across the length of the drum; water level is steady. Result—unit can carry high sustained demands or rapid load swings without pressure loss or effect on steam quality.

STEAM QUALITY—Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. In addition C-E drum internals, which reflect many years of development and experience, assure high quality steam at all ratings.

HIGH HEAT ABSORPTION—Closely spaced side wall tubes (3 in. dia. on 4-in. centers) plus fully water-cooled front wall not only assure highest heat absorption but reduce furnace maintenance to a minimum.

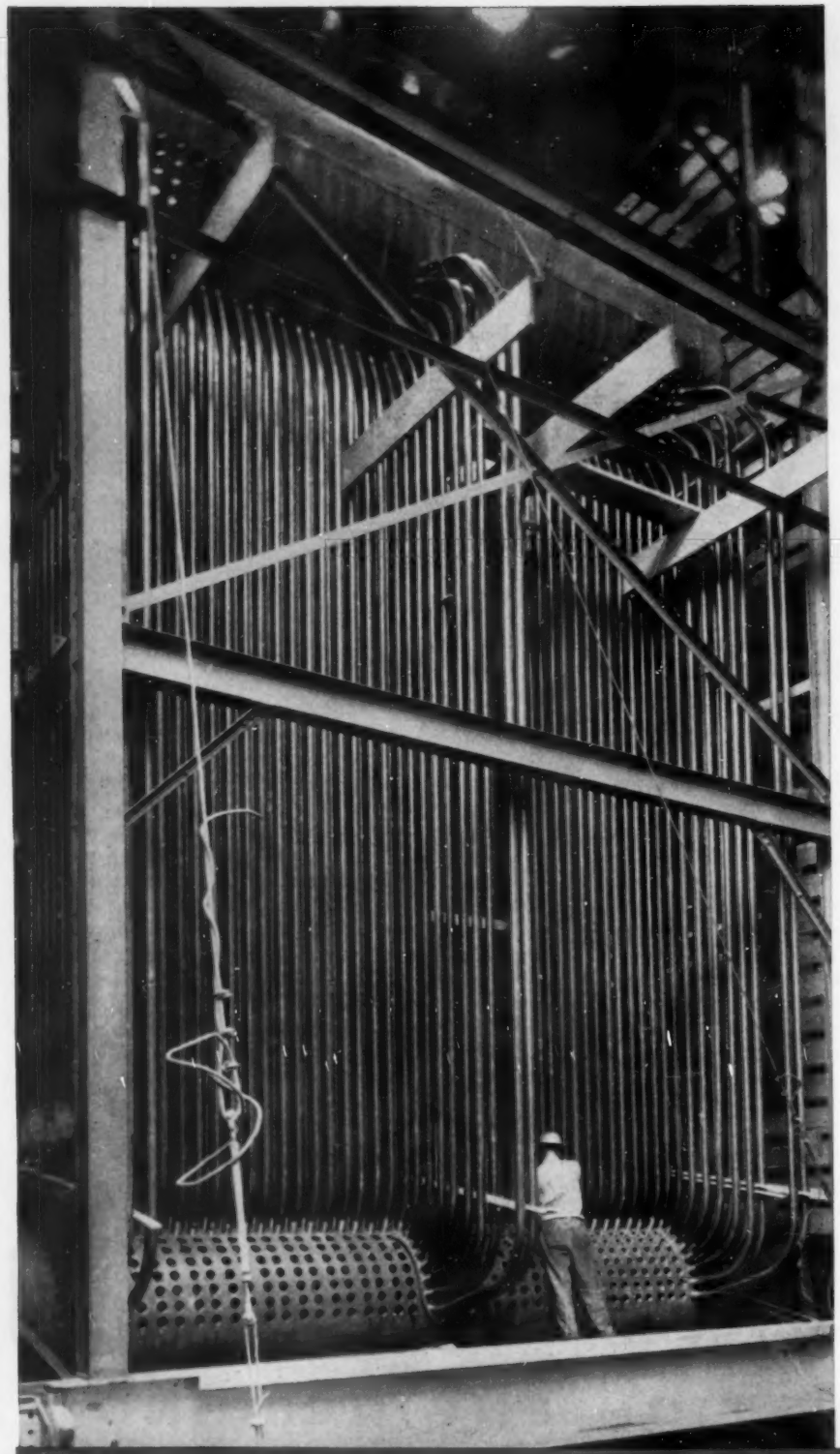
STREAMLINED EXTERIOR—The over-all appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing while retaining adequate access wherever required and every facility for convenient operation. There are, for example, no outside downcomer tubes and ducts from air heater to burners are beneath the furnace floor.

In selecting your next boiler unit please consider this: You may be able to buy steam generating capacity for less (first cost) than you'll get with a VU-55. But you can't buy better. It's a matter of record that many — perhaps most — boiler installations cost more for the fuel burned *each year* than the *original cost* of the boiler. Consider, too, that when you buy a boiler you *live with it* for 20 or 30 — or more — years. Looks like the wrong place to select equipment on first cost alone. So — do not fail to investigate Combustion's VU-55. A qualified C-E engineer will be pleased to discuss any details with you or your consultants.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y. B-777

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE



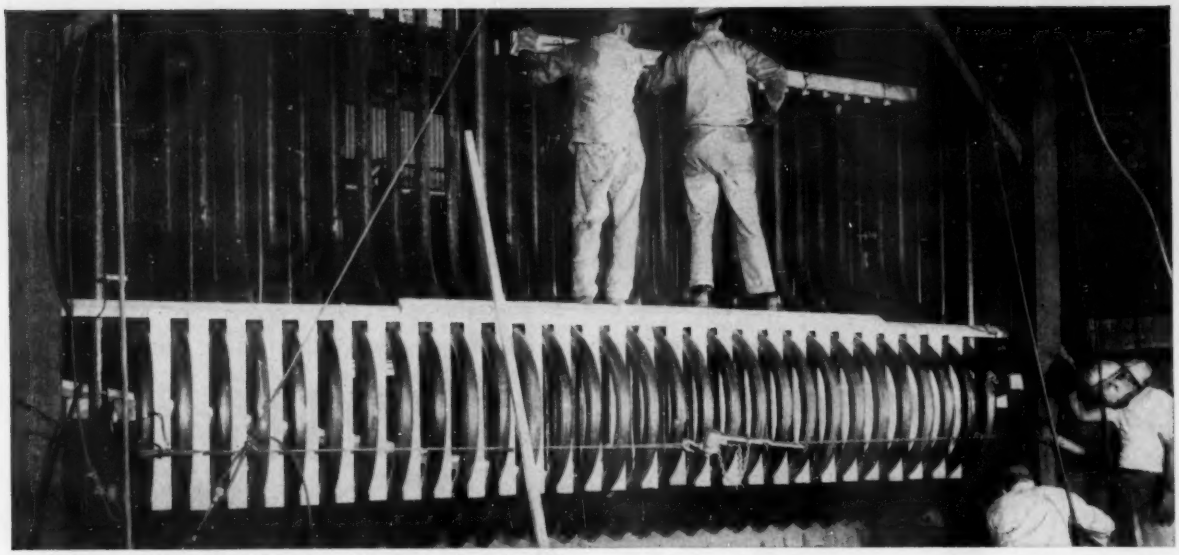
How to make sure

you get

"Intestinal Fortitude"—16 mm. sound, black and white film, 17 minutes. The story of ELECTRUNITE Pressure Tubes from ore to finished product. To arrange for a free showing, write to Republic Steel and Tubes Division.

Every ELECTRUNITE Boiler Tube has identical metallurgical and physical properties. Because wall thickness is uniform, there are no longitudinal thin spots. Heat transfer is uniform.

See our exhibit at the 21st National Exposition of Power and Mechanical Engineering, Commercial Museum, Philadelphia, Pa., December 2-3-4-6-7. BOOTH NO. 113.



Because ELECTRUNITE Boiler Tubes are uniformly ductile, springback can be accurately calculated before the bending operation. Result: smooth, accurate bends; a neat, efficient job with a minimum of adjustment.

the power you've bought

Like Kellogg Co., see that your new power plant is equipped with Republic ELECTRUNITE Boiler Tubes

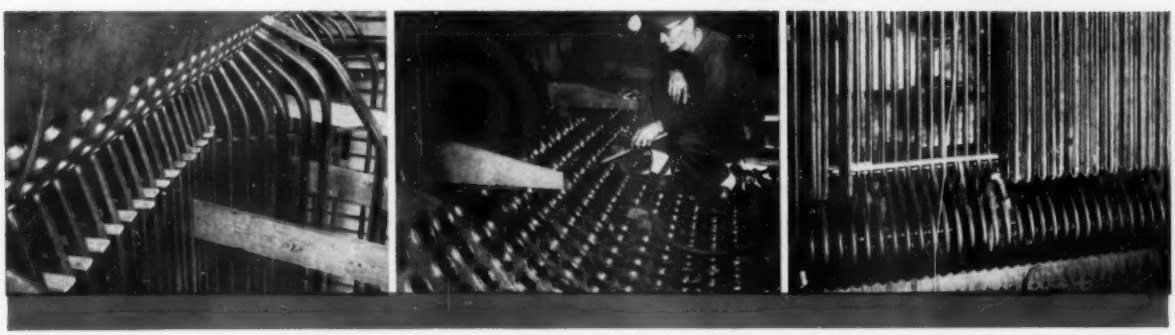
Dependable, Republic ELECTRUNITE Boiler Tubes are made from high-grade steel, produced in Republic's own mills. Operations are quality controlled from the time the ore is mined, through all manufacturing stages.

Tubes give uniform heat transfer, all around the tube, from end to end. Why? Because wall thickness is uniform. And because ductility is uniform, too, smooth bending and roller expanding are possible. Installation is easier, often less expensive.

It all adds up to a question of economics. If you take the long view on power plants, you'll want to consider Republic ELECTRUNITE Boiler Tubes. More and more consulting engineers are specifying them. Not only for old plants being modernized, but for new ones as well.

Before you decide on your specifications, get all the facts about Republic ELECTRUNITE Process and Pressure Tubes. Write for: BT-10.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
221 East 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York, 17, N. Y.

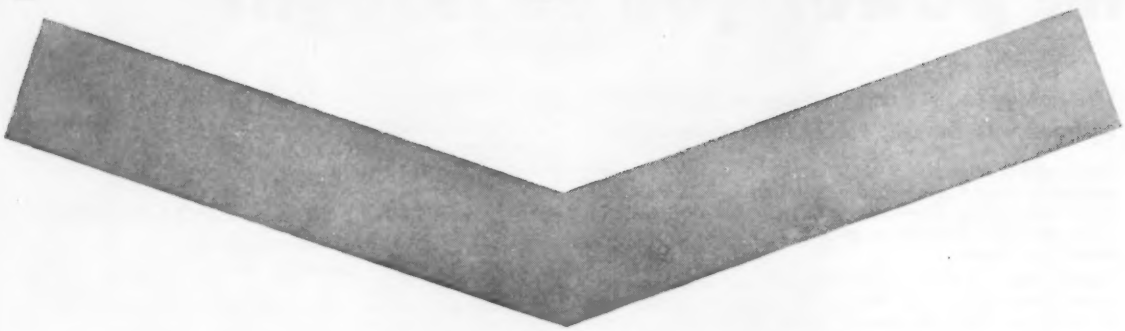


Boiler erectors like the way ELECTRUNITE Boiler Tubes slide easily into headers. The reason: uniform diameter, uniform ductility. Republic's quality control of ELECTRUNITE Boiler Tubes from ore to finished product makes this uniformity possible.

Because they are normalized in a controlled atmosphere, Republic ELECTRUNITE Boiler Tubes have scale-free surfaces. Grinding tube ends, which destroys uniformity, is not necessary. Tubes slide into drum holes easily, expand uniformly.

Part of the new 100,000 lbs./hr.—750 PSI—750 F. Steam Generating Unit installation at Kellogg Co., Battle Creek, Michigan. Designed, built and installed by Riley Stoker Corp., Worcester, Mass. Sargent & Lundy, Consulting Engineers, Chicago, Ill.

Only Brown flow meters offer you these profitable "*plus*" *values*

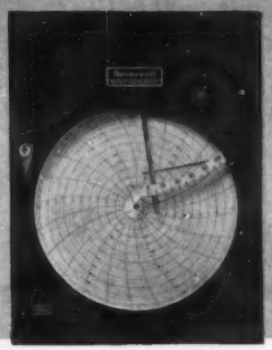


- ***16 different types*** of basic instrument systems . . . a flow meter for every fluid, every pressure, every operating requirement. *You're sure to find the most profitable meter for your specific application.*

- ***Nearby service facilities.*** There's a Honeywell service center as near to you as your phone. Service by factory-trained specialists is prompt, competent and economical. *You're sure to get maintenance and start-up service without delay.*

- ***27 years of experience*** in flow metering development and application work. *You're sure to get specialized engineering on your flow metering problem.*

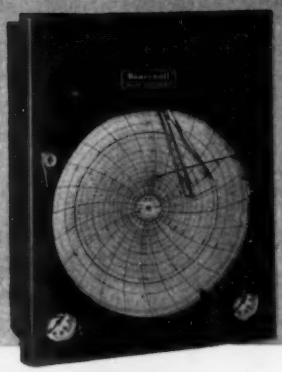
- ***Nationwide field organization.*** Brown flow metering consultation is available from experts in more than 90 field offices, located near every major production center. *You're sure to have application engineering on hand where and when you need it.*



Linear scale meters—mechanical or electrical types, all control forms.

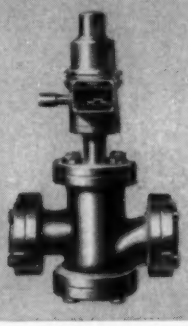
Square root scale meters—mechanical, or electrical or pneumatic transmission . . . all control forms.

Portable meters—versatility, for spot checks of flow values not continuously recorded.

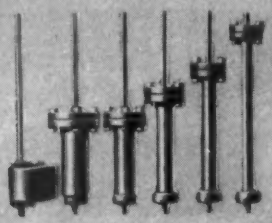


Low pressure meters—either electrical or mechanical type, for air or gas flow.

Differential Converter—mercury-less pneumatic flow transmitter with infinitely adjustable range.



Area Type Meters for measuring flow of viscous fluids . . . electrical transmission.



Interchangeable range tubes typify rangeability of all Brown flow meters.

NOTE:
Tel-O-Set miniature instruments and *ElectroniK* indicators, recorders and controllers are available for use with all flow transmitters.

a flow meter for every fluid...

every application (all available with electronic integration)

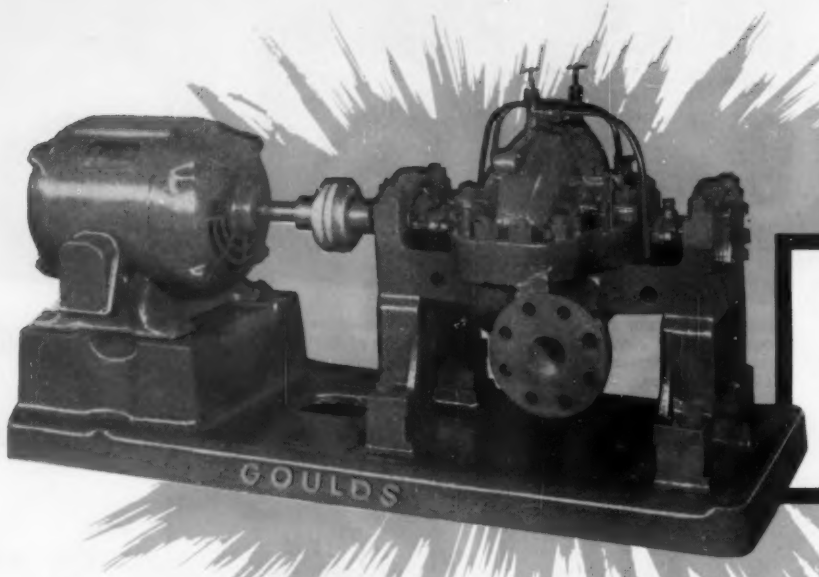
IN PERFORMANCE, too, Brown flow meters provide you unsurpassed precision . . . reliability . . . convenience . . . with minimum maintenance requirements. In every way, you'll find it pays to select your flow meters from the one line that offers the most value.

Your nearby Honeywell sales engineer will be glad to discuss your specific flow application . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Integrating, Controlling."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



announcing...

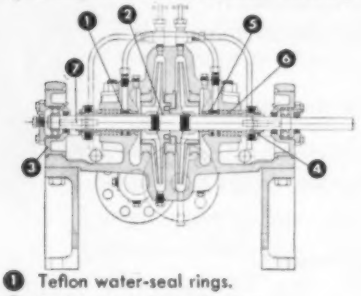
the Goulds Fig. 3305 two-stage, opposed impeller pump for clear liquids. 5 sizes. Capacities to 1200 GPM. Heads to 1000 ft.

This new Goulds pump offers you 5 specific operating and maintenance advantages . . .

To reduce your liquid-handling costs through greater standardization, easier maintenance, and improved operating characteristics, Goulds engineers have developed the *new* Goulds Fig. 3305 two-stage, opposed impeller centrifugal pump. Here are the highlights—the result of 50 years concentration on industry's centrifugal pump needs.

1 High operating efficiency, low maintenance cost

The Fig. 3305 pump combines the seven features indicated on the sectional drawing below to contribute a quality of dependable service which adds up to true operating and maintenance economy.



1. Teflon water-seal rings.
2. Stainless steel impeller key.
3. Bearing housing sealed against moisture and dirt.
4. Cowl-type glands suitable for use with quenching liquids.
5. Renewable stuffing box bushings.
6. Die-formed stuffing box packing.
7. Corrosion-resistant gland bolts.

2 Reduces your spare parts inventory

Only two shaft and rotating parts assemblies provide for 5 pump sizes and 10 pump combinations. This means a remarkable range of parts interchangeability which you will find detailed on page 7 of the descriptive bulletin. Furthermore, most of the components of the Fig. 3305 shaft and rotating assemblies are interchangeable in the Fig. 3405 single-stage, double-suction pump which has won industry-wide acceptance in the year since it was introduced.

This high degree of standardization helps materially to reduce spare parts inventories. It also gives you great flexibility in adapting your Fig. 3305 pump to changing field requirements.

3 Saves space

The short bearing span of Fig. 3305 pumps means considerable saving in floor space—as much as 50% in some comparisons with conventional designs of comparable capacity and head.

4 Stuffing box to match your requirements

You can choose either a conventional stuffing box with gland or a mechanical seal, according to your need. And you can easily change from one to the other at any time.

5 Simple to change rotation

A patented locking device makes it easy to change the rotation of this pump from right-hand to left-hand or vice versa *in the field and without additional parts.*

Before you select another pump for handling clear liquids at rates up to 1200 GPM and heads to 1000 ft., be sure you have the detailed cost-advantage story of Goulds new Fig. 3305 pump. We'll send you descriptive bulletin—promptly on request.

Get the complete story—This 12-page illustrated Bulletin No. 722.6, covers the new Goulds Fig. 3305 pump completely. It gives specifications, interchangeability tables, performance curves, dimensions.

MEMBER
HYDRAULIC INSTITUTE U.S.A.

Goulds PUMPS INC.
Seneca Falls
New York

ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK • PHILADELPHIA • PITTSBURGH • TULSA

Inside surface of inert gas tungsten arc weld root bead, "U" bevel, with "free-flowing" inert gas back up, is uniformly smooth.

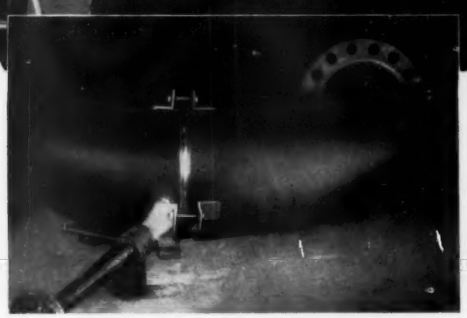
Here's How *Pittsburgh Piping* uses Inert Gas Tungsten Arc-Welding on Turbine Piping

Inert gas tungsten arc-welding, a standard production operation at Pittsburgh Piping, is used for the root pass on high-temperature, high-pressure piping.

U-grooves are precisely machine tool cut on pipe ends . . . the ends are accurately aligned and butted, ferritic materials preheated to desired temperature, then tack-welded.

Air inside the pipe is displaced with "free-flowing" inert gas and the root pass is made at a uniform rate, at comparatively low voltage, using a tungsten electrode shielded with inert gas. The weld is then thoroughly inspected for uniformity and soundness.

Conventional arc-welding methods are used to complete the weld, the connection is stress-relieved, and then thoroughly inspected by special non-destructive tests. This procedure, combined with other P.P.&E. techniques, eliminates need for backing rings and double butt welding, and produces a sound, clean joint having a remarkably uniform root bead of correct internal contour.



Turbine pipe, 2¼% Chrome—1% Moly steel, is preheated before making root pass.

Pittsburgh Piping

AND EQUIPMENT COMPANY

10 Forty-Third Street—Pittsburgh, Penna.

Atlanta.....Whitehead Building	Cleveland...Public Square Building
Boston.....10 High Street	Houston...Heights State Bank Bldg.
Charlotte.....221 Builders Building	Los Angeles.1830N. Alexandria Ave.
Chicago.....Peoples Gas Building	New Orleans.....P. O. Box 74

New York.....Woolworth Building

PP-7

custom built systems
HAGAN
automatic
combustion controls
HAGAN
ring balance
instruments
For thirty-five years the leaders in advancing steam production efficiency with Automatic Combustion Control and Instrumentation Systems.
HAGAN
HALL
BUROMIN
CALGON

from standard components

Custom Built from standard components sounds like a contradiction. But it is a fact that each Hagan unit is designed, not only to perform its specific functions efficiently, but also to operate smoothly in combination with other Hagan components. Thus, every Hagan System of Automatic Combustion Control and Instrumentation can be custom built to maintain the exact operating conditions which result in optimum steam production efficiency.

Thirty-five years of experience with all types of boilers, and with every combination of temperature, pressure and fuel system requirements, goes into the design of every Hagan unit and system. As a result, a Hagan System is thoroughly coordinated and easy to calibrate. Adjustments are ample in number and range, so that our engineers—or yours—can get the entire system into accurate operation with a minimum loss of time.

Many of our customers have standardized on Hagan Controls and Instruments for improving existing facilities and for extensions and new construction.

Make Hagan Automatic Combustion Control and Instrumentation the choice for your next installation!

HAGAN CORPORATION

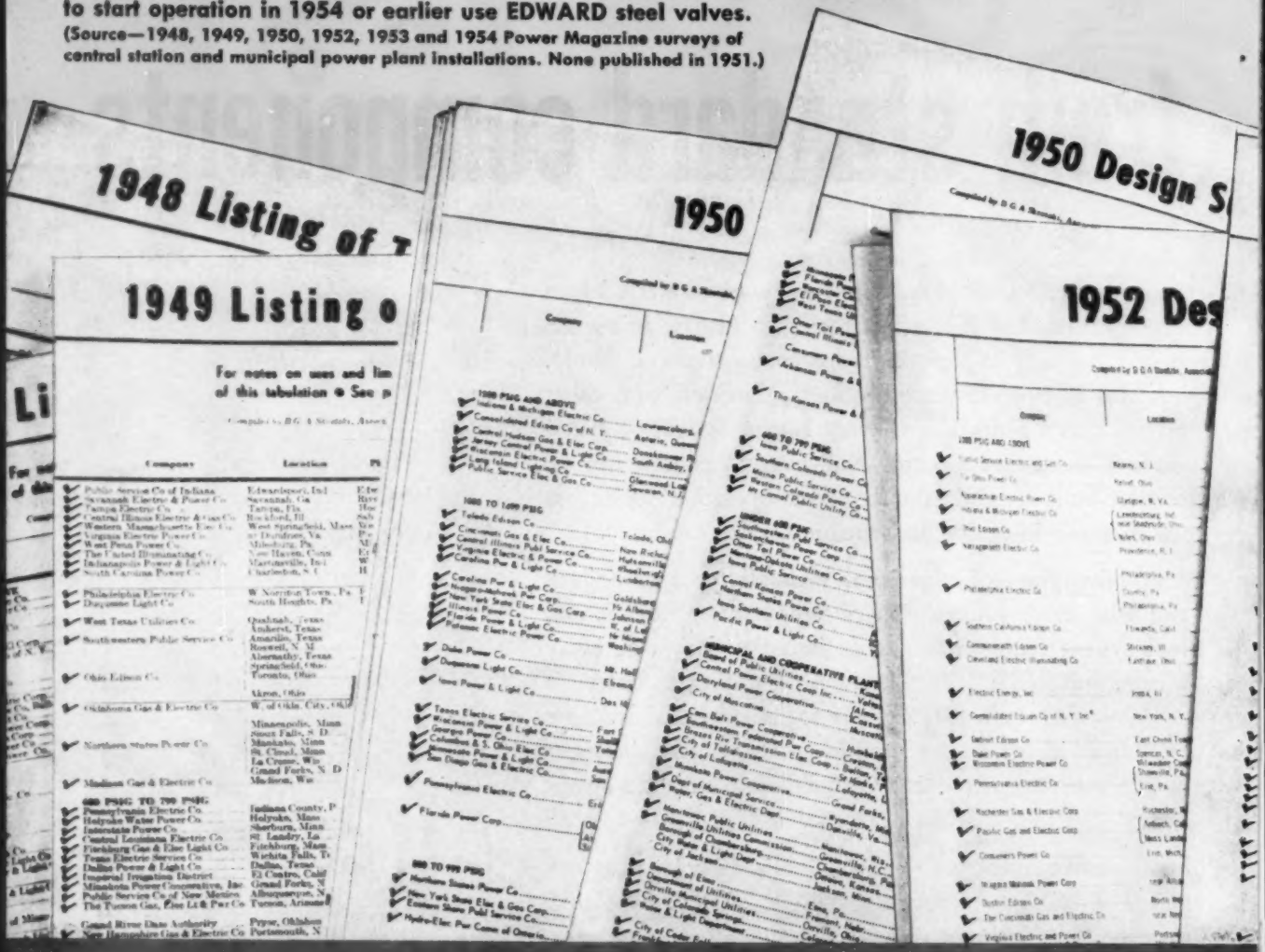
HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities

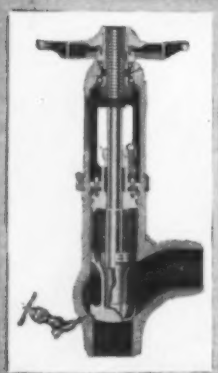
Again in '54 it's Edward Valves

THE EVIDENCE: **674 out of 699 (96.42%) of new central station and municipal power plant projects scheduled to start operation in 1954 or earlier use EDWARD steel valves.**

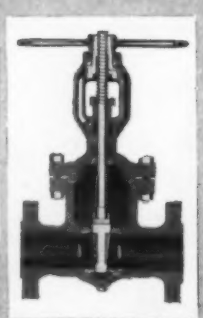
(Source—1948, 1949, 1950, 1952, 1953 and 1954 Power Magazine surveys of central station and municipal power plant installations. None published in 1951.)



TYPICAL EDWARD DESIGNS GOING INTO NEW STATIONS

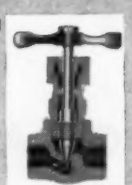

Cast Steel Non-Return

Cast Steel Stop

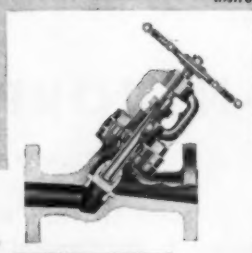

Cast Steel Gate

Cast Steel Check

Forged Gage



Forged Stop


Blow-off

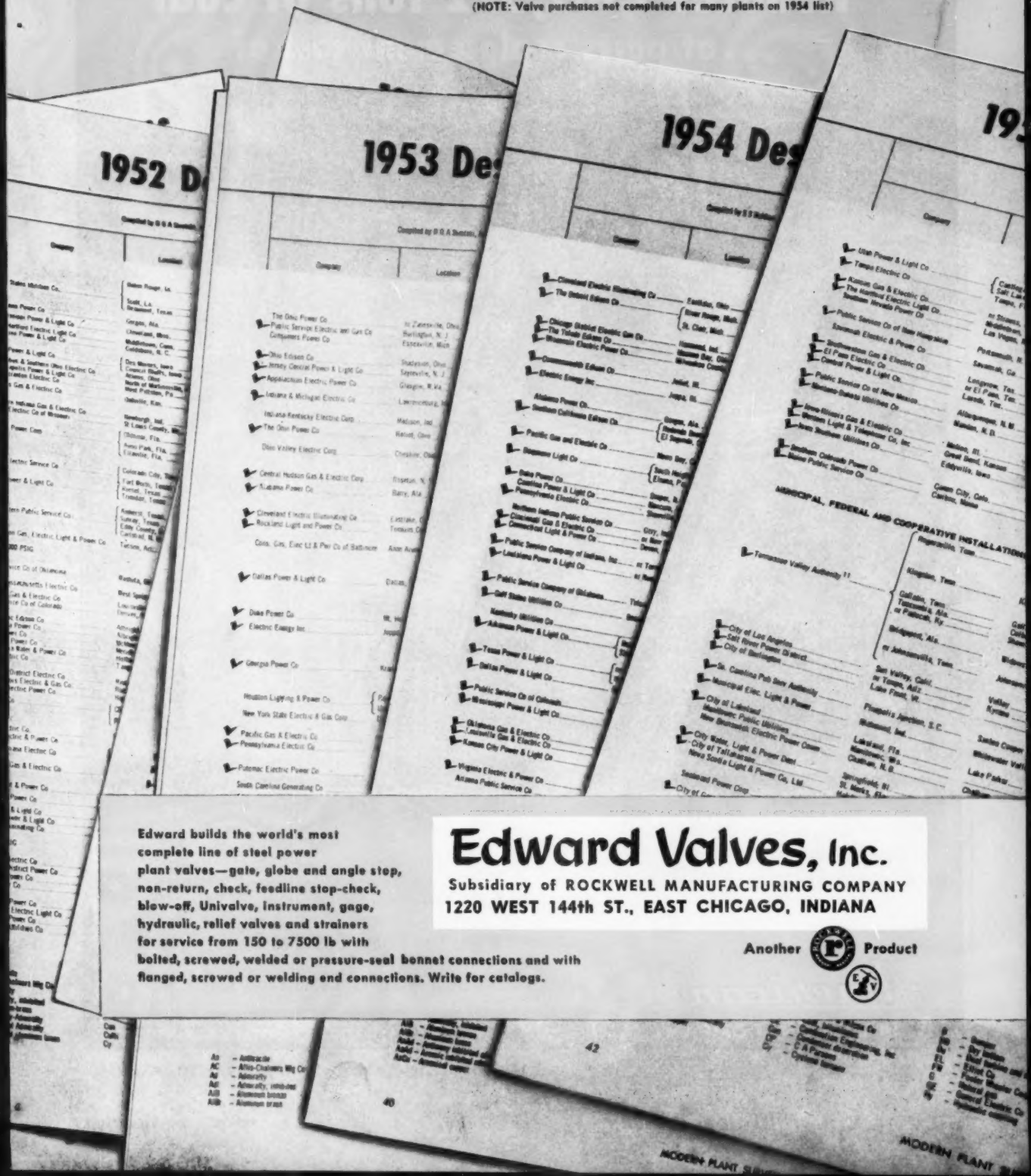
Forged Instrument

Forged Univalves

in over 96% of new power plants

✔ **Indicates identified purchases of Edward valves for specific generating capacity additions. In the 1954 survey, records show Edward valves in 39 out of 40 new plant additions scheduled to start operation 1954 or earlier, a 97.5% acceptance.**

(NOTE: Valve purchases not completed for many plants on 1954 list)



Edward builds the world's most complete line of steel power plant valves—gate, globe and angle stop, non-return, check, feedline stop-check, blow-off, Univalve, instrument, gage, hydraulic, relief valves and strainers for service from 150 to 7500 lb with bolted, screwed, welded or pressure-seal bonnet connections and with flanged, screwed or welding end connections. Write for catalogs.

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

1220 WEST 144th ST., EAST CHICAGO, INDIANA

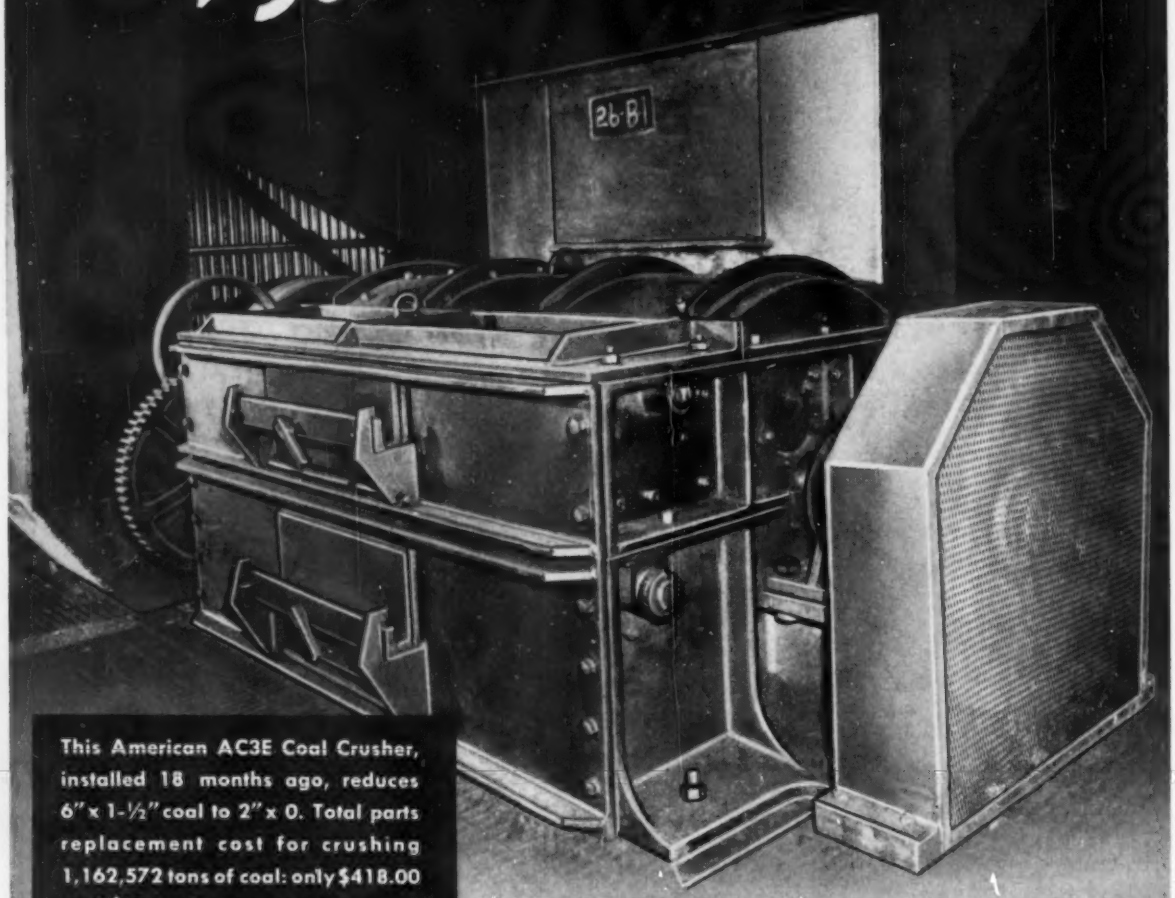
Another Product

AMERICAN ROLLING RING CRUSHER

Reduces 1,162,572 Tons of Coal

...at parts replacement cost of

1/30th of a cent per ton!



This American AC3E Coal Crusher, installed 18 months ago, reduces 6" x 1-½" coal to 2" x 0. Total parts replacement cost for crushing 1,162,572 tons of coal: only $418.00 or 1/30th of a cent per ton.

"When You Figure Cost Per Ton...
the Best Answers Come From American"

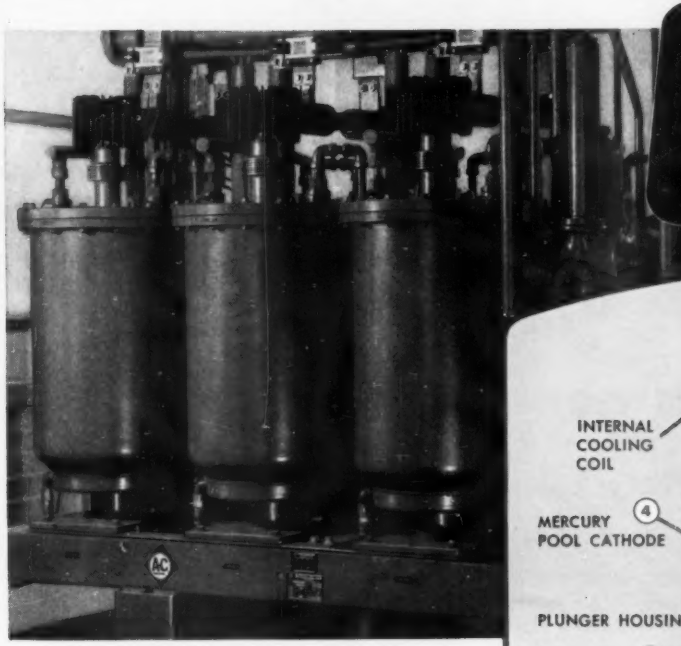
American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

Here's the Rectifier That Needs

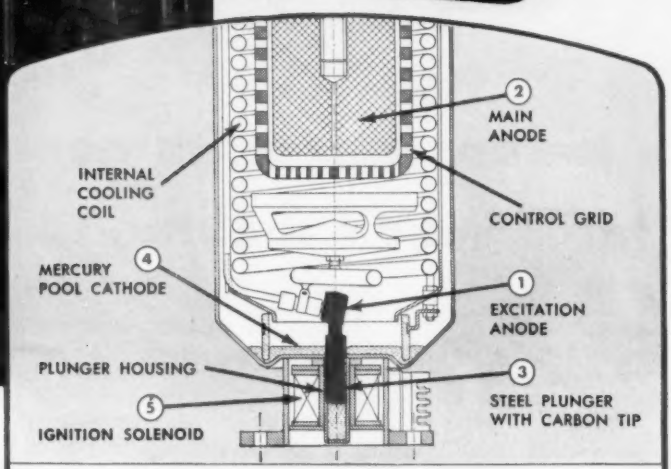
No Delicate Adjustments



THIS 1000-KW, 615-VOLT DC, six-tube excitron rectifier is installed in an automatic transportation substation.

ALLIS-CHALMERS

Mercury Arc Rectifiers



Unique Plunger Starts Continuous Excitation

The excitron tube has an excitation anode ① in addition to the main anode ② . With the excitation circuit de-energized, the steel plunger ③ floating in the mercury pool cathode ④ makes positive contact with the excitation anode (as shown).

When the excitation circuit is energized, the ignition solenoid ⑤ pulls the steel plunger ③ away from the excitation anode ① and under the mercury pool cathode ④ , thus drawing a dc arc and forming the cathode spot, which makes conduction of load current by the tube possible.

If power is interrupted the plunger will float up, contact the excitation anode and automatically re-establish the excitation arc when power is restored.

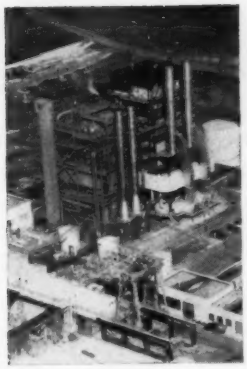
LITTLE MAINTENANCE IS NEEDED with Allis-Chalmers excitron-type rectifiers. Excitation of the excitron rectifier is continuous, while other types of rectifiers require re-ignition 60 times a second.

Since it is more difficult to start a rectifier arc than to maintain it, the excitron rectifier is much less likely to lose excitation during operation. Momentary dips in supply voltage which are encountered in many supply systems have no effect on the continuous excitation arc.

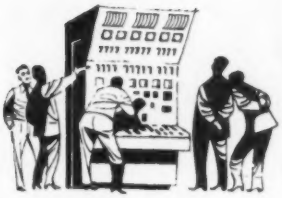
Years of operation in hundreds of installations have proved the reliability and ease of operation of Allis-Chalmers mercury arc rectifiers. You can get complete information from your nearby A-C office. Or write Allis-Chalmers, Milwaukee 1, Wis.

A-4432

ALLIS-CHALMERS



Louisiana Power & Light Company's third unit at Ninemile Point Plant designed by Ebasco Services, Incorporated with Instrumentation and Control by Hays.



MORE AND MORE **CENTRAL STATIONS** ARE SELECTING **HAYS** INSTRUMENTS AND CONTROL

New ideas in instrumentation and control featured in outdoor boiler plant

MEET DEMANDS OF LATEST TYPE BOILER IN SPACE SAVING, GREATER SPEED OF RESPONSE, ALTERNATE FUEL FIRING.

Practically every detail of the third unit of Louisiana Power's new Ninemile Point generating plant is of the newest design. An all-weather outdoor boiler with Hays electric type combustion control—gas fired, with provisions for "stand-by" oil firing—will produce 1,000,000 lbs. of steam per hour, superheated and reheated to 1,005° F. . . . adding a capability of another 135,000 KW to Louisiana's power program.

On outdoor boilers electrically operated combustion control is especially preferred because it doesn't require expensive compressors and dryers, allows maximum freedom in the location of the control room.

To answer operators' demands for more instruments in less space, Louisiana Power is installing a miniature remote control station. This Hays benchboard, which is four feet wide contains all important remote control elements—manual adjustments for the boiler, turbine and generator.

For faster speed of response and greater accuracy a number of Hays electronic instruments are being installed. Among these are—electronic mercury-less flow meters and 3 element electronic feedwater control.

Among the central stations recently selecting Hays instrumentation and control are: Jersey Central Power and Light Co., Northern Indiana Public Service Co., Central Illinois Electric and Gas Co., St. Joseph Power and Light Co., Crawfordsville Power and Light Co.

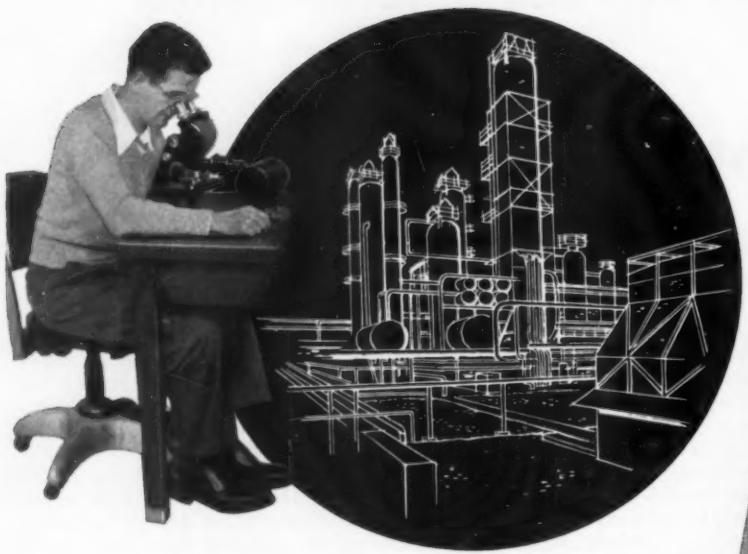
Write for Hays Boiler Plant Instrumentation Bulletin 54-605-83.

THE **hays** CORPORATION

MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

is corrosion costing you too much?



our job at Globe is to keep this costly problem at a minimum — through the use of GLOBE Steel Tubes, produced for your specific requirements!

THERE are over twenty-five basic grades of stainless steel tubing, variations of which add up to many more analyses which can be employed in solving your corrosion problems.

Globe's metallurgists and engineers help you minimize the expense caused by corrosive attack. By careful laboratory and field study of your processes and products, they will recommend just which of the many available analyses of Globe tubing is best suited to your job.

Globe's "one source" supply offers seamless and welded stainless, and seamless carbon and alloy steel tubes in a complete range of sizes and analyses. Write for the Globe General Catalog.

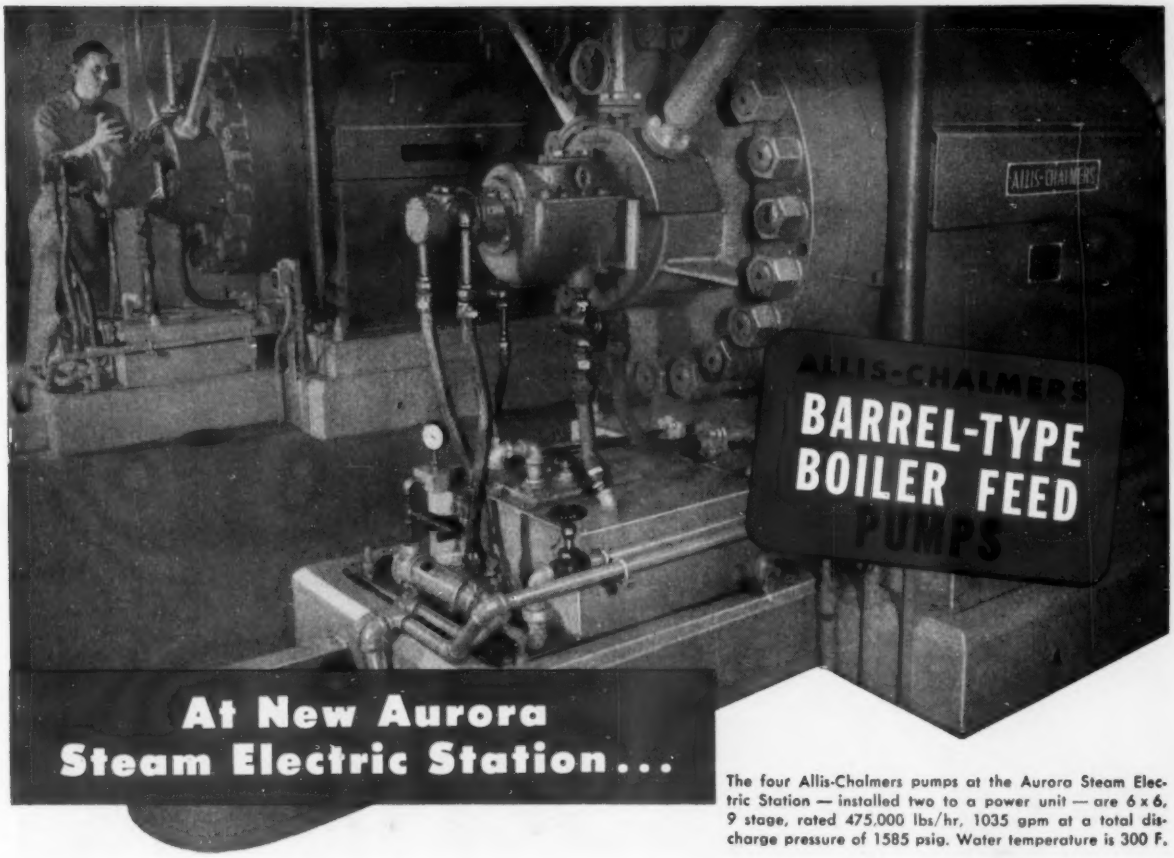
Producers of Globe seamless stainless steel tubes — Globeweld welded stainless steel tubes — seamless alloy and carbon steel tubes — seamless Globeiron (high-purity ingot iron) tubes — Globe Welding Fittings

GLOBE

STEEL TUBES CO.

Milwaukee 46, Wisconsin

Chicago • Cleveland • Denver
Detroit • Houston • Los Angeles
New York • Philadelphia
San Francisco
St. Louis



The four Allis-Chalmers pumps at the Aurora Steam Electric Station — installed two to a power unit — are 6 x 6, 9 stage, rated 475,000 lbs/hr, 1035 gpm at a total discharge pressure of 1585 psig. Water temperature is 300 F.

Minnesota Power & Light Installs 4 of these Highly Reliable Pumps

THE NEW 88,000-KW AURORA STEAM ELECTRIC PLANT at Aurora, Minn., is a model of modern design and efficiency. Equipment was carefully chosen for its ability to provide extra dependable, low-cost operation.

On this basis Minnesota Power & Light Co. — working with its consulting engineers, EBASCO SERVICES INCORPORATED — bought four Allis-Chalmers barrel-type boiler feed pumps.

WHAT ARE YOUR PUMP NEEDS?

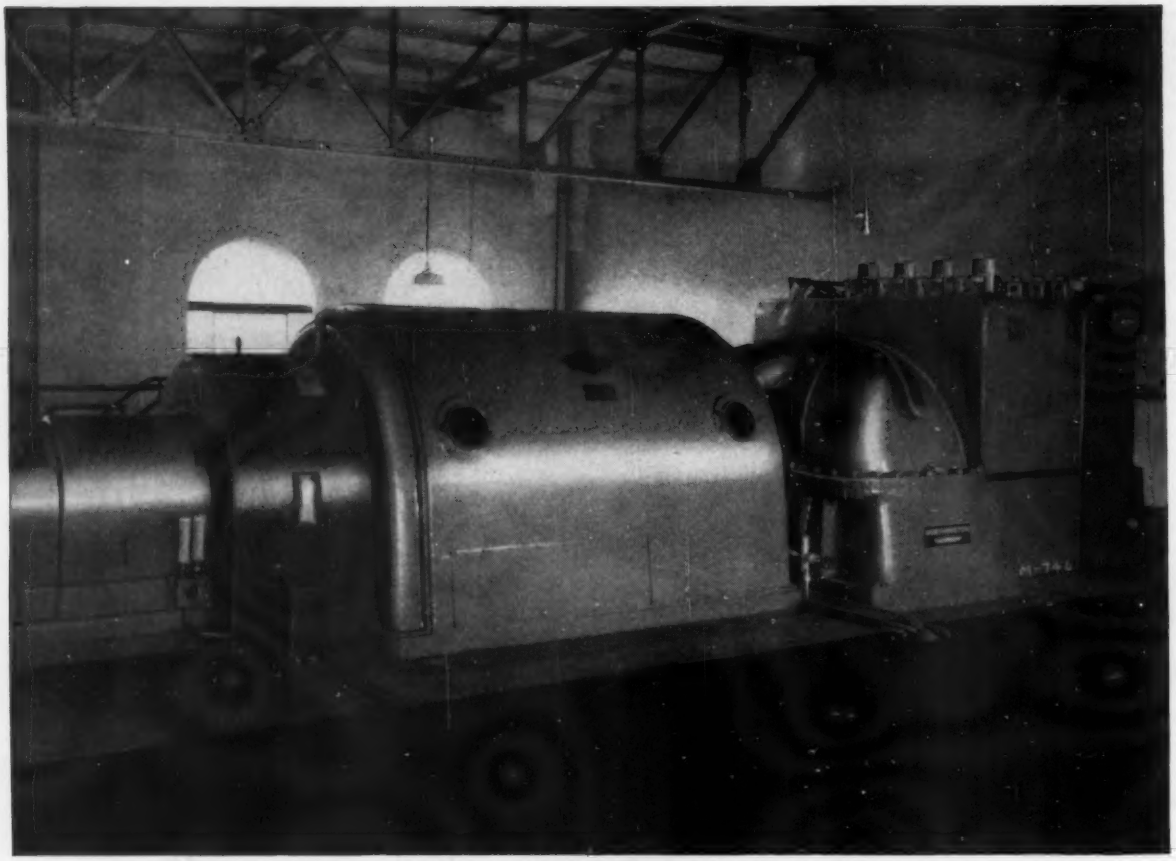
Whether you require boiler feed, condensate, circulating or other power plant pumps — a careful study will reveal why more and more utilities are specifying Allis-Chalmers. Check the design features, the operating advantages, the provisions that make a pump easier to maintain, or service. You, too, will find it pays to standardize on Allis-Chalmers Power Plant Pumps.

ONE SOURCE FOR THE ENTIRE UNIT

Allis-Chalmers can supply the complete unit of pump, motor and control — all of coordinated design and manufacture. And you get one responsibility, one reliable guarantee of satisfaction covering the whole unit. A-4407

For detailed information, call your A-C district Office or write Allis-Chalmers, Milwaukee 1, Wisconsin. Ask for bulletin 08B7899.

ALLIS-CHALMERS



NEWEST OF THREE WORTHINGTON POWER UNITS installed in Detroit Lakes' Minn., municipal power plant is this 4000-kw extraction-condensing turbine-generator.

Production up-fuel costs down

That, in brief, is the happy story of the municipal power plant at Detroit Lakes, Minnesota.

Here's what happened. For the past few years Detroit Lakes has been modernizing its power plant. This program, highlighted by the installation of Detroit Lakes' third Worthington turbine-generator, has reduced fuel costs by more than 23% — despite a steady increase in plant output.

Other Worthington equipment also contributed to this fine performance record. The Worthington condenser, steam jet air ejector, air compressor, and cooling water, condensate and feedwater pumps all played their part in keeping production up — and costs down.

It's clear that this Worthington equipment has paid off for Detroit Lakes. Not so evident is the secure feeling the Detroit Lakes people get from knowing that every Worthington unit is designed, assembled and tested as a complete unit *before* shipment.

This undivided responsibility can mean dollars saved for you, too. Get the whole story from your nearest Worthington district office. Or write to Worthington Corporation, Steam Turbine Division, Section T.4.6, Wellsville, N.Y.

T.4.6

WORTHINGTON

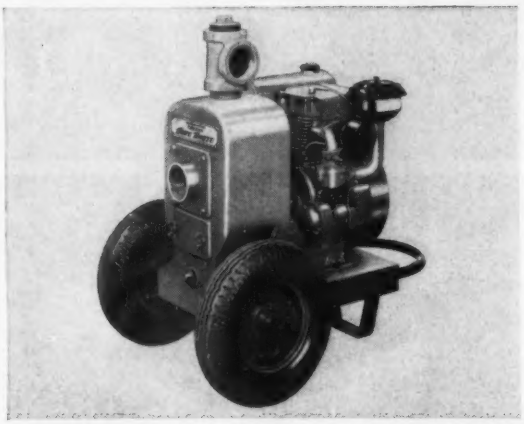
STEAM TURBINES

Single and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers

A GREAT TEAM IN STEAM

Photo courtesy of Fort Worth Star-Telegram.

Don't let emergencies shut down your production



WORTHINGTON'S SELF-POWERED, SELF-PRIMING PORTABLE PUMP is ideally suited for emergency service in industrial floods, or for pumping from sumps or excavations. Size 20-I is shown.

A fast-acting Worthington emergency pump might have kept this plant operating

You can't always prevent an industrial flood, but you can often control it with a Worthington self-priming, self-powered portable pump. What's more, you'll probably be able to get the flood water cleaned up in time to keep production on schedule, too.

Especially designed for emergency service, these centrifugal pumps are self-powered for use in the event of electrical failure. They're portable and self-priming, too, so they can go into action immediately when needed. And they have suction lifts up to 25 feet at sea level for removing floor water trapped in sumps, pits, ditches, trenches or other excavations.

The Worthington self-priming portable pump line includes seven units with ratings of 4,000 to 42,000 gallons per hour. Write for complete information to Worthington Corporation, Centrifugal Pump Division, Section C.3.3, Harrison, New Jersey.

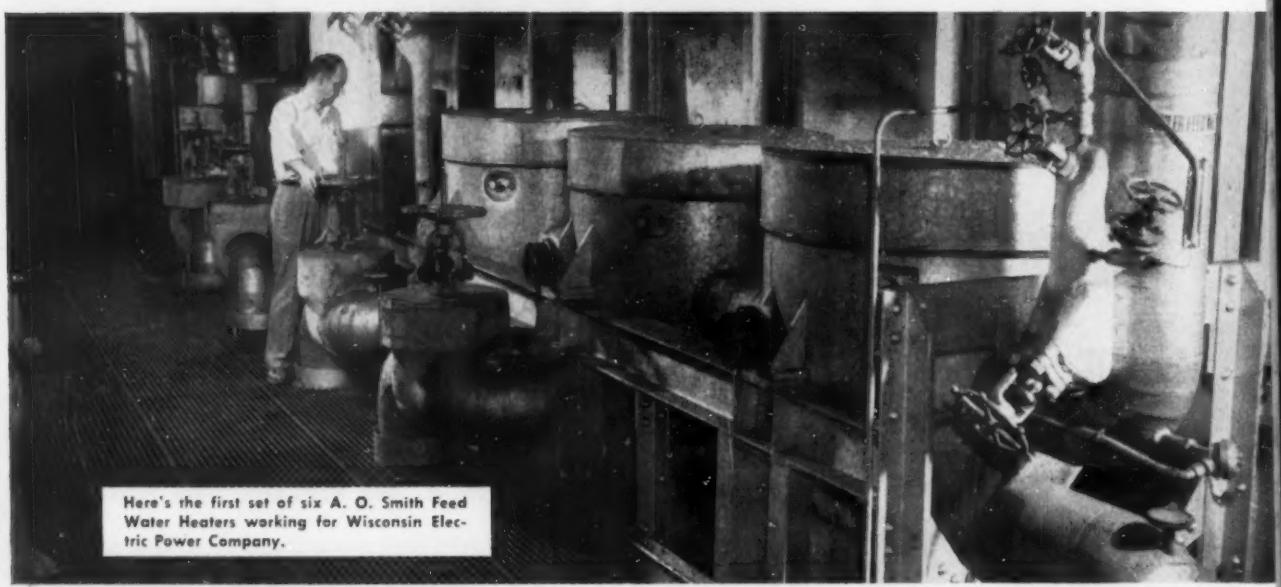
C.4.1

WORTHINGTON

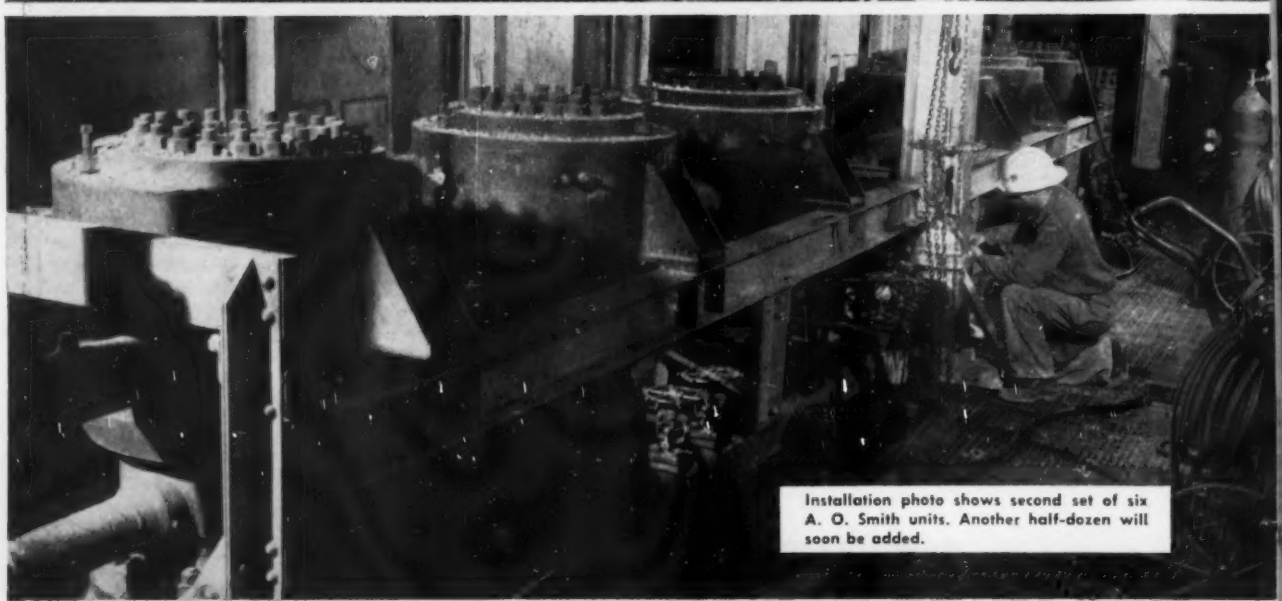
THE WORLD'S BROADEST LINE ASSURES YOU THE RIGHT PUMP FOR EVERY JOB

CENTRIFUGAL • ROTARY • STEAM • POWER • VERTICAL TURBINE

Third set of A. O. Smith Feed Water Heaters ordered by Wisconsin Electric Power Company



Here's the first set of six A. O. Smith Feed Water Heaters working for Wisconsin Electric Power Company.



Installation photo shows second set of six A. O. Smith units. Another half-dozen will soon be added.

The Oak Creek plant, pictured here, is located on the shores of Lake Michigan near Milwaukee.

A. O. SMITH is proud to be associated with Wisconsin Electric Power Company's Oak Creek plant — Wisconsin's largest. The new features designed into these steam turbine generator units make it one of the country's most modern plants.

Now on the job at Oak Creek are two sets of six A. O. Smith Feed Water Heaters. These will soon be augmented by another bank of six . . . each bank designed with desuperheating and drain cooling sections.

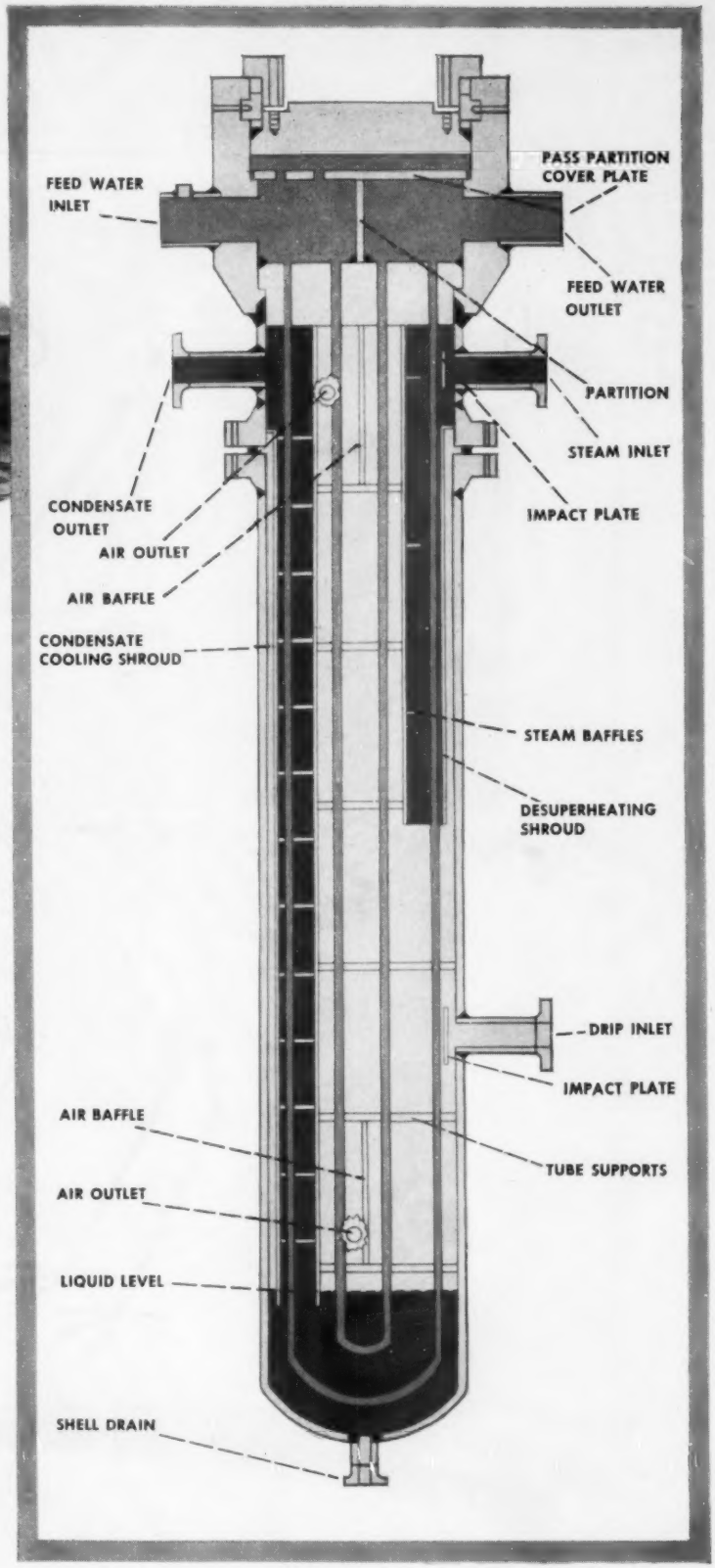
These A. O. Smith units are built for operating pressures of 2,400-2500 psi. End closure and channel test out at 4,800 psi. Inside diameter is 24 inches, while overall lengths are up to 23 feet.

Exchanger designs, proved through years of service, make specifications of 1,000 to 10,000 psi *standard* in our exchanger and vessel shops. *Special* heat transfer problems, too, can be solved best by A. O. Smith, because our thermal design group is recognized as one of the finest in the country. You'll profit most by contacting A. O. Smith first.

Through research A.O. Smith *. . . a better way*

A.O.Smith
CORPORATION

PROCESS EQUIPMENT DIVISION
Milwaukee 1, Wisconsin
International Division: Milwaukee 1

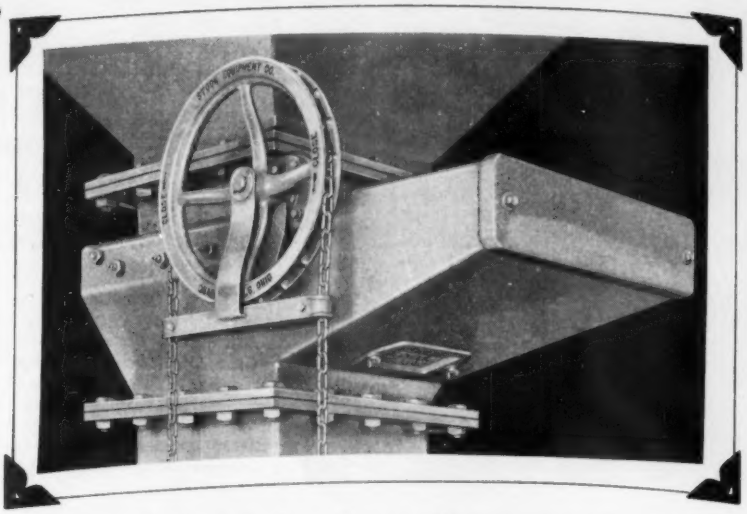


Cutaway drawing shows a Feed Water Heater of the type used by Wisconsin Electric Power Company.

It's BRAND SPANKING NEW!

BABY'S NAME *The New S·E·Co. Coal Valve*

BABY'S PHOTO

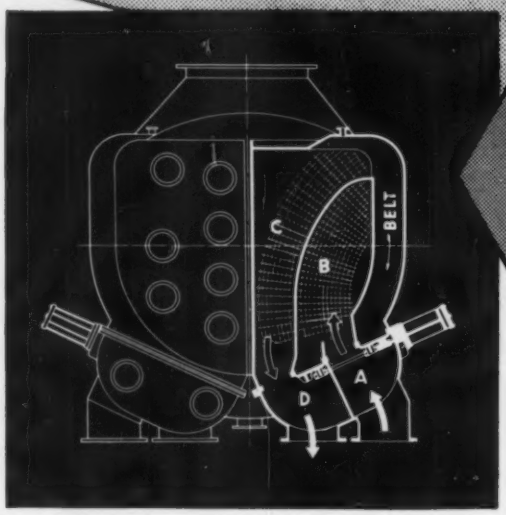


BABY'S WEIGHT *Very substantial—long life expectancy*

FEATURES *Deep U section gate—self-cleaning racks and pinions—lap seal four sides of gate—same super quality inherent in entire S-E-Co. line.*

PROUD PARENTS *The Stock Equipment Company*
745 Hanna Bldg., Cleveland 15, Ohio.

C. H. WHEELER "SELF CLEANING" PATENTED REVERSE FLOW STEAM CONDENSER



REVERSE FLOW

Illustrated is the C. H. Wheeler tandem arrangement in which both sluice gates operate on a single stem. In this divided water box condenser, water enters chamber A with left hand port open and flows in through pass B, out through pass C and through left hand port D. To reverse the flow, gates move to left, closing the left hand ports and opening the right hand ports of chambers A & D. Water now flows through belt, in through C and out through B and right hand port of D. The same method applies, of course, to a non-divided water box design.

No Shutdown — No Vacuum Loss for Tube Cleaning

The C. H. Wheeler Patented Reverse Flow design makes either single or divided water box steam condensers self-cleaning. These condensers are saving power plants countless hours of downtime and reduced load formerly required for manual removal of debris and organic growth from clogged tube sheets.

"Self-Cleaning" is accomplished by a set of sluice gates built integrally into C. H. Wheeler Surface Condensers which may be electrically or hydraulically operated to reverse the flow of cooling water through the tubes. This sudden flushing-in-reverse removes all debris and crustaceous matter and carries it out the discharge while carrying full load on the turbine and without reducing water flow. Also, the quick change in temperature shocks and dislodges marine growth.

Depending on condition of the cooling water, C. H. Wheeler Reverse Flow condensers have gone two years and longer before requiring cleaning. A typical field report tells of regaining a half-inch loss of vacuum (due to fouled tubes and tube sheets) five minutes after reversing the flow of condenser cooling water.

C. H. Wheeler custom - designs Reverse - Flow Condensers to suit any installation, arranging sluice gates and nozzles at top or bottom of water box and at any angle desired. Call a C. H. Wheeler representative to go over your specifications. It will mean years of substantial savings.

(BULLETIN 410 mailed on request)

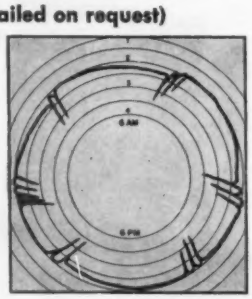
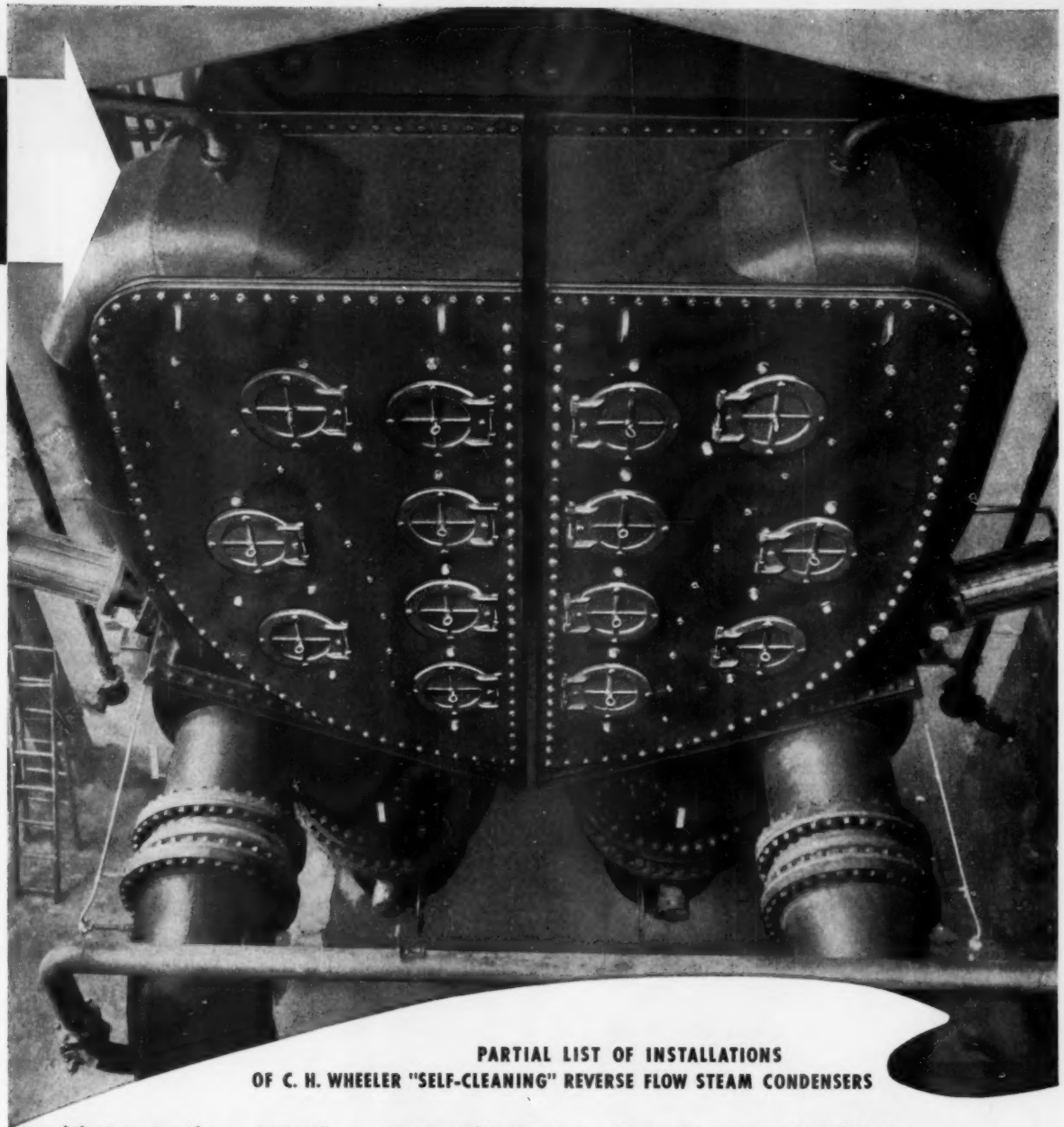


Chart shows typical cycle of vacuum and effect of reverse flow in a C. H. Wheeler Patented Self-Cleaning Reverse Flow Condenser. Note that because of 100% back flushing, the loss of vacuum during the reverse flow cycle is negligible.

SEE IT AT THE POWER SHOW — PHILADELPHIA, DECEMBER 2, 3, 4, 6, 7



PARTIAL LIST OF INSTALLATIONS
OF C. H. WHEELER "SELF-CLEANING" REVERSE FLOW STEAM CONDENSERS

General Electric Co., Lynn Plant . . 8,900 sq. ft.
General Electric Co., Lynn Plant . . 12,500 sq. ft.
Keystone Steel & Wire, Peoria . . 10,000 sq. ft.
Virginian Railways, W. Va. . . . . 15,000 sq. ft.
City of Wyandotte, Mich. . . . . 12,000 sq. ft.
City of Kansas City, Kansas. . . . 32,500 sq. ft.
New Bedford Gas & Edison Light,
New Bedford, Mass. . . . 16,500 sq. ft.
New Bedford Gas & Edison Light . 25,000 sq. ft.
Connecticut Light & Power Co.,
Montville Station . . . . . 24,000 sq. ft.

Connecticut Light & Power Co. . . 24,000 sq. ft.
Connecticut Light & Power Co.
Devon Station . . . . . 50,000 sq. ft.
Georgia Power Co., Atkinson Station, 47,000 sq. ft.
Alabama Power Co , Units 1 & 2
Gadsden Station . . . . . 47,000 sq. ft.
City of Holland, Michigan . . . . . 13,000 sq. ft.
South Carolina Electric & Gas,
Unit #1 Urquhart Station . 45,000 sq. ft.
South Carolina Electric & Gas,
Unit #2 Urquhart Station . 45,000 sq. ft.

Connecticut Light & Power,
Montville Station . . . . . 55,000 sq. ft.
Monongahela Power Company,
Albright #3 . . . . . 65,000 sq. ft.
Georgia Power Company,
Hammond Station, Units 1-2-3, 74,000 sq. ft.
City of Jacksonville, Fla.,
Southside Station . . . . . 40,000 sq. ft.
Tallyrand Station . . . . . 40,000 sq. ft.

C. H. WHEELER *of Philadelphia*

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Vacuum Refrigeration
High Vacuum Process Equipment • Micro-Particle Reduction Mills • Marine Condensers and Ejectors • Deck Machinery

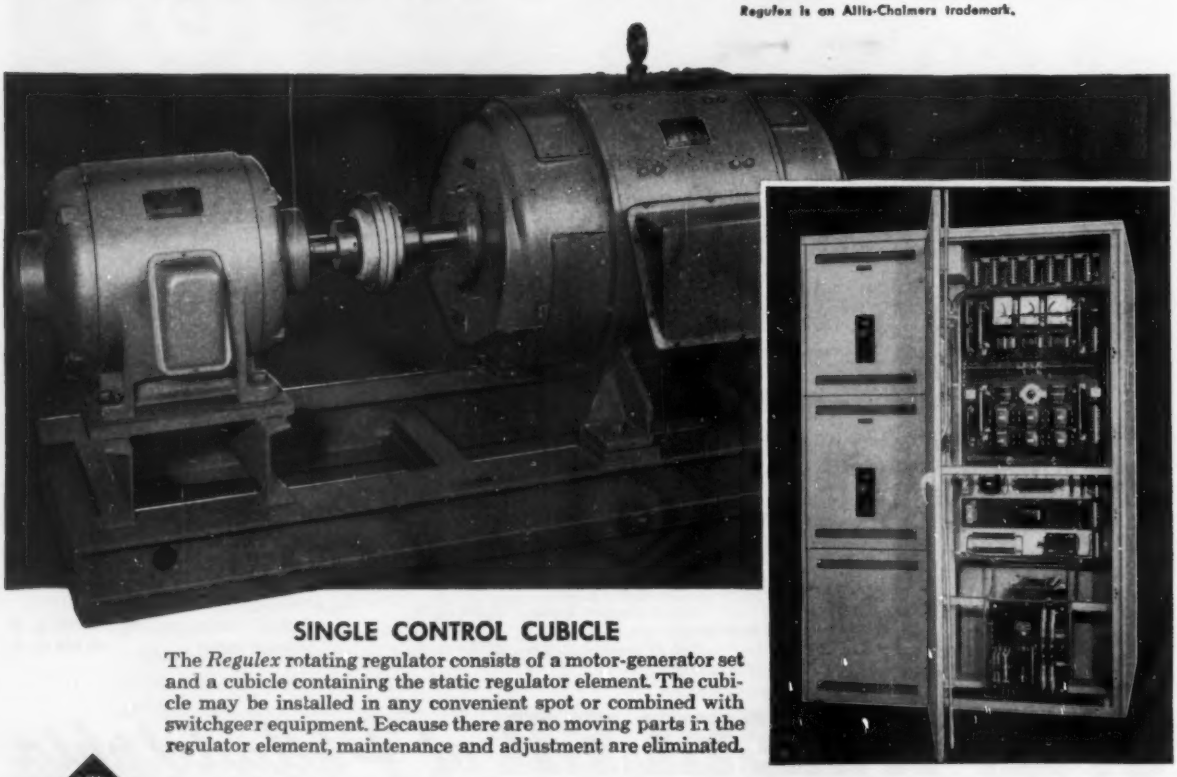
When power demands GROW

...gain additional Kilowatts with...

VOLTAGE REGULATORS

GENERATORS straining under the demand for ever-increasing kilowatt output take a new lease on life with the addition of *Regulex* voltage regulators. Automatic minimum excitation afforded by the *Regulex* voltage regulator allows the generator to operate close to the pull-out limit. Exceptional sensitivity and rapid response establish and maintain a safe ratio between generator load and field current. Operating limits at any given power factor are increased . . . best reactive kva division assured. It all adds up to maximum safe kilowatt output . . . more power to sell from your present generating equipment. For complete information call your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4369

Regulex is an Allis-Chalmers trademark.



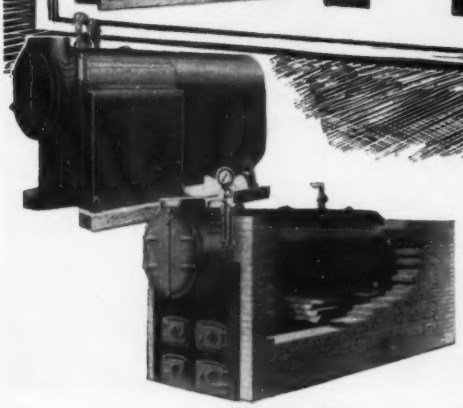
SINGLE CONTROL CUBICLE

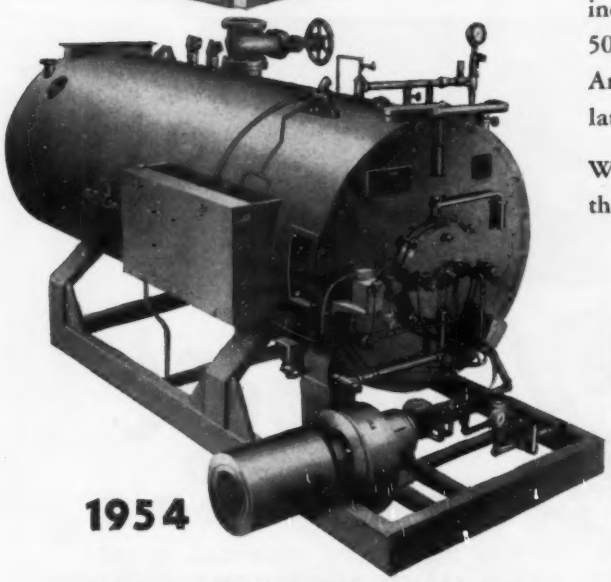
The *Regulex* rotating regulator consists of a motor-generator set and a cubicle containing the static regulator element. The cubicle may be installed in any convenient spot or combined with switchgear equipment. Because there are no moving parts in the regulator element, maintenance and adjustment are eliminated.

ALLIS-CHALMERS

106 YEARS of RELIABILITY ARE BEHIND EVERY AMESTEAM GENERATOR

1848





1954

AMESTEAM GENERATOR

20 sizes, 10 to 600 H.P., 15 to 200# W.P., oil, gas, or oil-gas combinations with quick fuel switchover feature.

In your selection of a boiler, it's important to remember — experience *does* count. And what better assurance of top boiler quality do you have than the Ames record: 106 years of building fine boilers — boilers which have given economical, satisfactory service throughout the industry! Many Ames units purchased 40 to 50 years ago are still faithfully on the job. Amesteam Generators always incorporate the latest advances in package boiler design.

Write today for details on these boilers with the proven record of reliability.

AMES IRON WORKS, INC.
Box H-114, Oswego, N. Y.

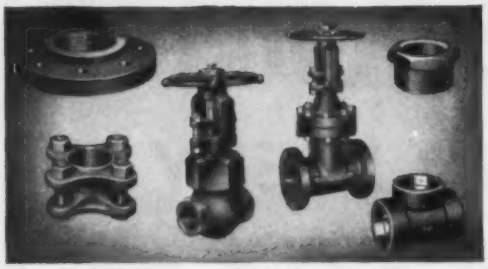
Show me how I can benefit from Ames experience and nation-wide organization in getting a top boiler value.

NAME.....

ADDRESS.....

COMPANY.....

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

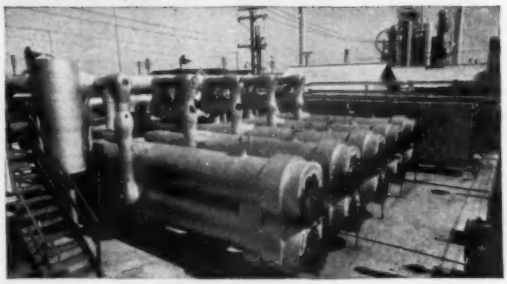
Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

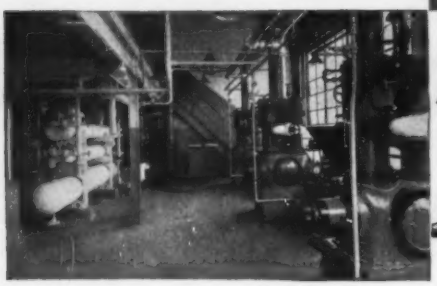
PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.



MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

Vogt

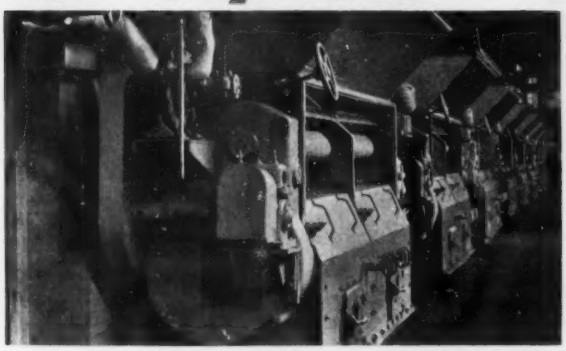
PRODUCTS

FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

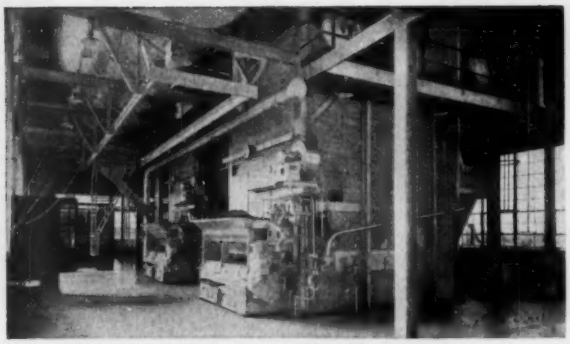
HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland St. Louis, Dallas, Charleston, W. Va.

for any load

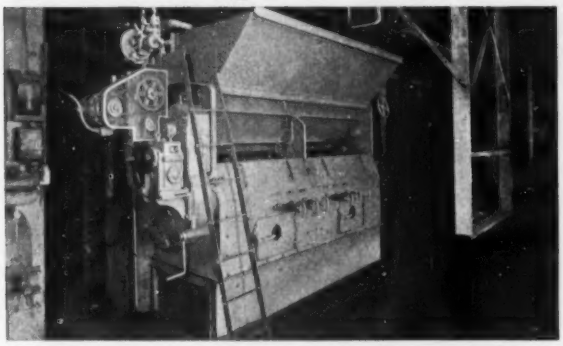


CLAIRTON WORKS—U. S. STEEL CORP.—Nine 540 H.P. Stowes—selected after careful study of all types—doubled the output of existing boilers, eliminated smoke nuisance and substantially reduced steam costs.

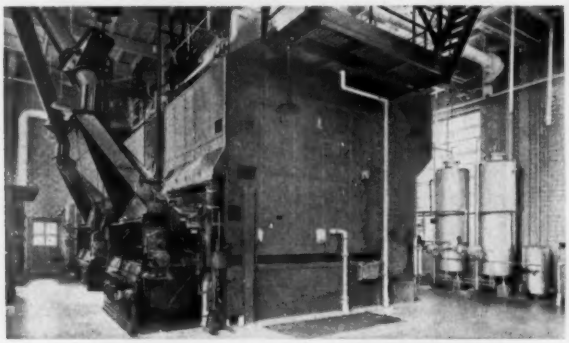


STATE HOSPITAL—Two 40,000 Lbs./Hr. Stowe Stokers burn inexpensive local coal, handle — without difficulty—loads that fluctuate in ratio of 16 to 1 combine utmost ease and simplicity of operation.

you'll get more efficiency

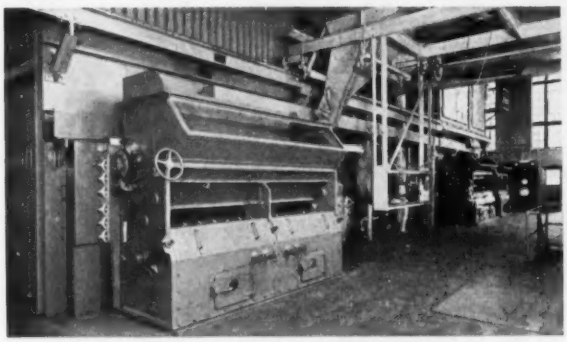


SMALL MUNICIPAL LIGHT PLANT 50,000 Lbs./Hr. Stowe replaced a multi-retort stoker—increased the boiler output—reduced maintenance costs and eliminated smoke and fly ash nuisance.

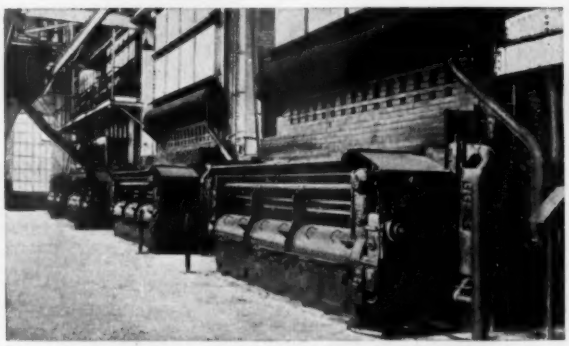


M & R DIETETIC LABORATORIES, INC.—Two 35,000 Lbs./Hr. Stowe Stokers meet exacting requirements for efficiency and smoke free operation in industry where cleanliness and low cost is paramount.

with a Stowe



UNIVERSITY OF DETROIT—Three Stowes of 300 H.P., 500 H.P. and 500 H.P. respectively, installed one after another, based on demonstrated efficiency and absence of smoke nuisance in residential area.

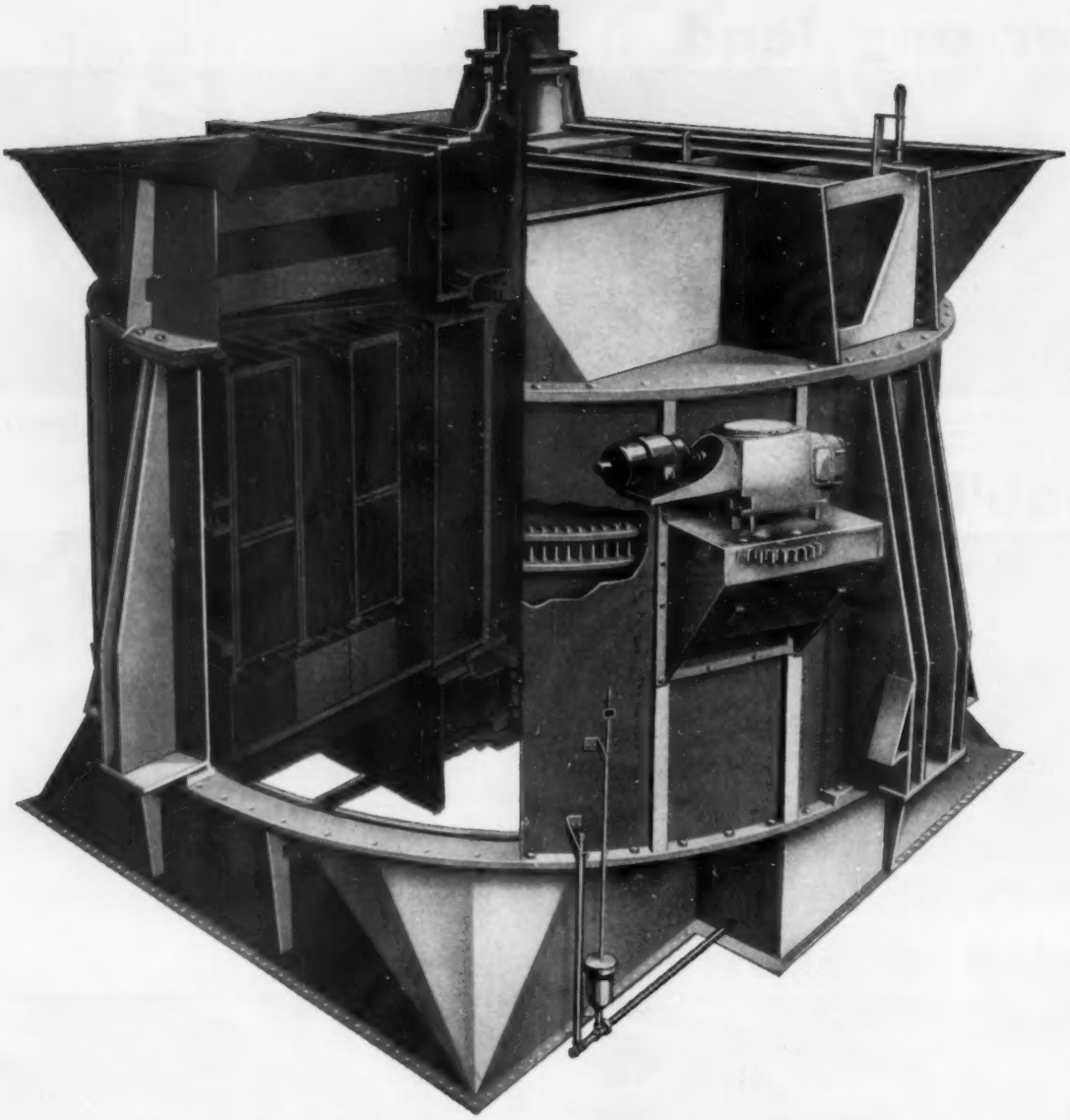


BODY PLANT OF LARGE AUTOMOBILE BUILDER—Stowes under four 90,000 Lbs./Hr. boilers burning inexpensive coal at high efficiency and no smoke nuisance. Concern now has 10 Stowes in its several plants.

"More Power to You" with **STOWE** *Stokers*

Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio

.... *Division of* PETTIBONE MULLIKEN CORP...



THE LJUNGSTROM AIR PREHEATER

cuts fuel costs in hundreds of plants

The Ljungstrom Air Preheater has proved its value in industrial and utility plants throughout the country. That's why every year, a constantly increasing percentage of the total installed boiler capacity is Ljungstrom-equipped. *Your fuel costs will drop, too,* when you equip your boilers with Ljungstroms. The extremely high efficiency of the regenerative design means the greatest possible recovery of waste heat . . . with substantially lower fuel requirements.

If you are planning a new boiler installation – or expanding or modernizing your present one – let our engineers show you how the Ljungstrom can raise over-all efficiency in your plant.

Ljungstrom Air Preheaters are now available for boilers of any type or capacity from 25,000 pounds of steam per hour up.

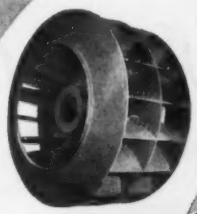
The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

NOT A WEAK LINK

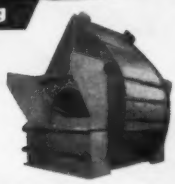
IN THE CONSTRUCTION OF

"BUFFALO" INDUCED DRAFT FANS

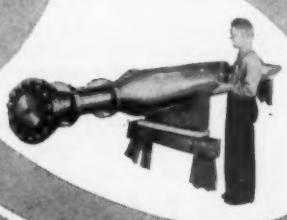
rotor



housing



bearings



shaft

So much depends on the continued operation of your draft fans that it pays to be sure that there are no weak links in the construction. Housings, wheels, blades, bearings and shafts — *all* must be up to the job, or the fan as a whole cannot function.

Every part of a "Buffalo" Induced Draft Fan is built up to stand known conditions of wear, heat and erosion. The shaft is turned from a solid piece of forged steel with extra large thrust collars. Bearings are heavy-duty, self-aligning and water-cooled. Housings are heavy-gauge steel, hot-riveted, with removable scroll liners where erosion is most severe. Blades are built up with welded-on wearing strips. In short, every "link" in the construction of these fans is designed for maximum long life in this punishing fan job.

It is all part of the "Q" Factor* which assures you of best results whenever you buy "Buffalo". Write now for Engineering Bulletin 3750.

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

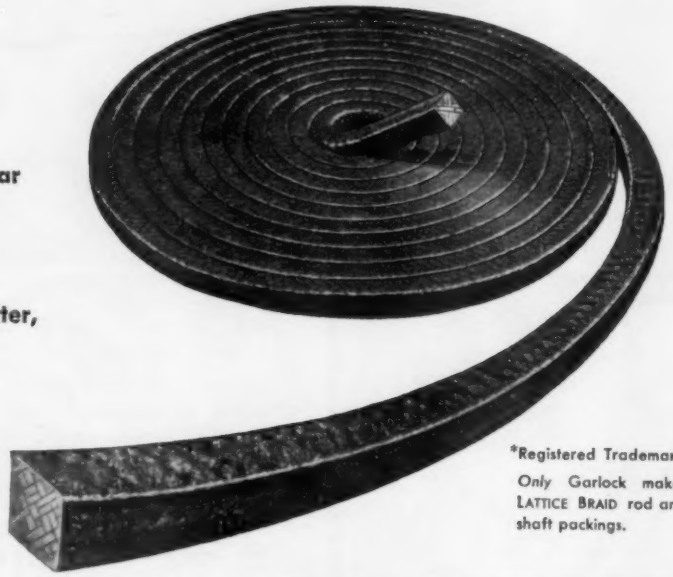
Sales Representatives in all Principal Cities

"Buffalo" DRAFT FANS

** The "Q" Factor — The built-in quality which provides trouble-free satisfaction and long life.*

Service Reports show that
LATTICE BRAID* Packing
has these 5 Big Advantages
over ordinary braided packings:

1. Requires *less* gland pressure
2. Causes *less* sleeve and shaft wear
3. Retains lubrication *longer*
4. Does *not* unravel; thus makes better, more uniform rings
5. Lasts *much* longer



*Registered Trademark.
Only Garlock makes LATTICE BRAID rod and shaft packings.

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

Get all the facts about LATTICE BRAID Packings. Contact your Garlock representative or write for new folder AD-131.

TYPICAL SERVICE REPORTS

▶ **SEWAGE DISPOSAL PLANT**—On sewage pumps handling sludge and grit, 80 to 125 p.s.i., 7/8" and 1/2" packing. Both Garlock 733 and 740 LATTICE BRAID Packing hold together better, retain lubricant longer, and cause less shaft wear than previous packings. In addition, LATTICE BRAID lasts 4 times longer.

▶ **PAPER COMPANY**—On defibrator handling water and wood pulp, 175° F., 200 p.s.i., 3/4" packing. Best service from previous packing was 2 weeks. Garlock 733 LATTICE BRAID Packing lasts 13 weeks.

▶ **MEAT PACKER**—On circulating pumps (centrifugal) handling water, 55° to 80° F., 40 to 250 p.s.i., 3/4" packing. Customer prefers Garlock 732 LATTICE BRAID Packing for this service because it does not unravel and because it makes better, more uniform rings.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N. Y.) • Philadelphia • Pittsburgh • Portland (Ore.) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK LATTICE BRAID PACKING

It takes Six Bolts -

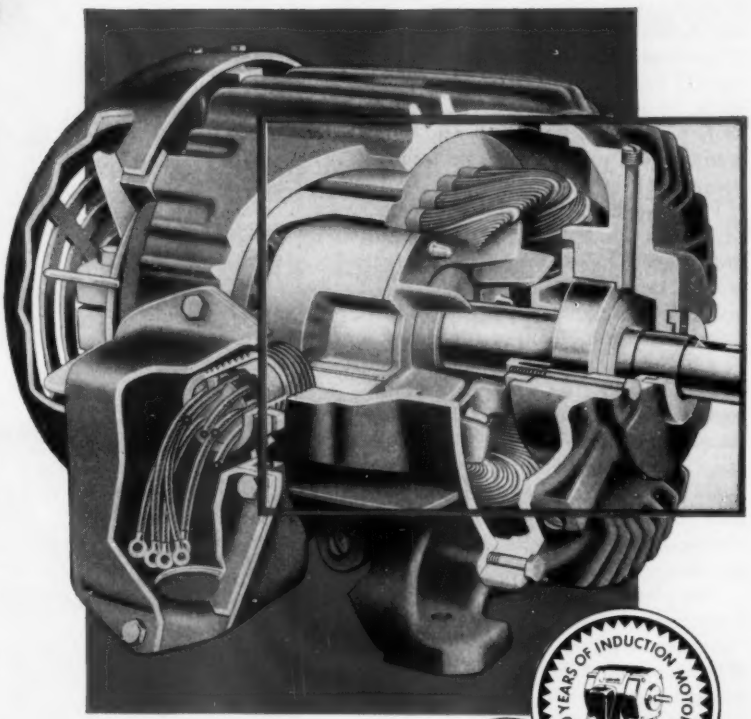
not just four

to give full bearing protection for greater motor performance

THE TWO EXTRA BOLTS in the end housing of every Allis-Chalmers ball bearing motor are the proof of *extra* protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.



50 YEARS OF INDUCTION MOTORS
ALLIS-CHALMERS NORWOOD WKS.

Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS CHALMERS

A-4444

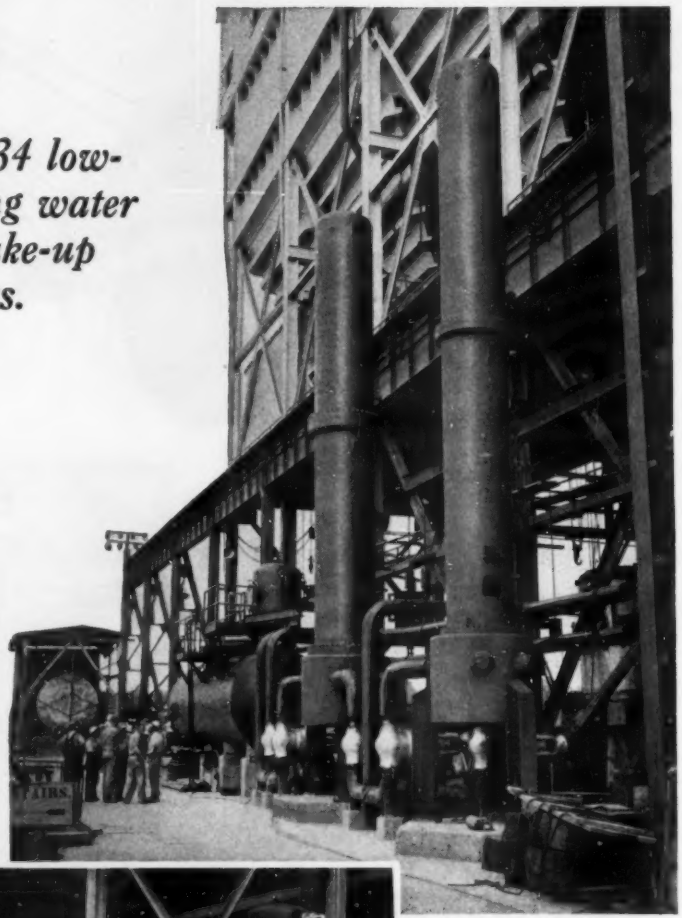
68 units to serve
JOPPA STEAM-ELECTRIC STATION

Feedwater installation by Foster Wheeler includes 12 high-pressure heaters, 34 low-pressure heaters, 18 cooling water exchangers (including make-up heaters) and 4 evaporators.

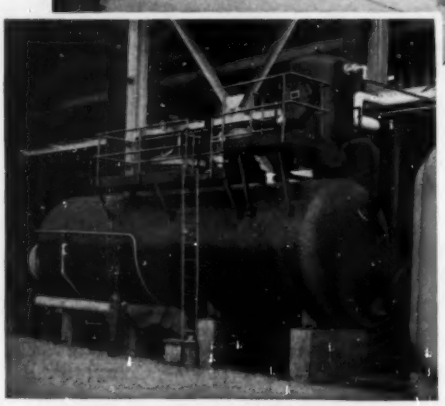
Constructed by Electric Energy, Inc. to supply approximately half of the power for AEC's Paducah Area Project, the Joppa Steam-Electric Station is designed for 937,500 KW in six boiler and turbine units. Of the semi-outdoor type, it represents one of the largest electric power stations ever planned for one building operation.

Few installations require the number of heaters which this new station will have when completed; probably none can boast of larger high-pressure heaters. The six crossover high-pressure heaters each have a surface of 7,760 sq ft capable of heating 1,162,700 lb of feedwater per hr from 411.1 F.to 470.4 when supplied with steam at a pressure of 497 psia, total temperature of 721.1 F. The six 10th-stage high-pressure heaters each have 4,858 sq ft surface. Each set is equipped with desuperheating, condensing and drain-cooling sections, and is built for handling 3200 psi, 500 F water.

The closure for these high-pressure heaters incorporates the well-known "Lockhead" feature. A patented Foster Wheeler construction, this closure provides a means for supporting the head pressure load that is separate from that for supporting the gasket compression load. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.



▲ Crossover and 10th-stage feedwater heaters. Crossover heater is approximately 38' high. Shell design pressure is 550 psi at 800 F; tube design pressure 3200 psi at 500 F.



◀ Foster Wheeler evaporator with deaerating preheater. Total heating surface 3450 sq ft capable of evaporating 30,000 lbs net vapor per hr.

FOSTER WHEELER

Stability of Performance on the job

CLARAGE
TYPE NH, CLASS II-A
FORCED DRAFT FANS

dependable **BROAD** efficiency, rather than S^H^A^R^P peak efficiency

No tendency toward unstable, unpredictable performance!

With the Clarage Type NH Fan you get efficiency where it counts: under actual operating conditions. Modern manufacturing techniques assure that each of these fans is accurately constructed to perform according to its rating and in line with its advanced design.

As fully described in Bulletin 802, Type NH, Class II-A forced draft fans are provided with independent bearing pedestals, split type housings, and non-overloading, backwardly inclined wheels (diameters 15" to 66").

Users agree that here is thoroughly dependable equipment fully answering within its performance range the requirements of modern power plants. For heavier duty forced draft service, Clarage fans are available in Classes III and IV construction.

Request Bulletin 802

CLARAGE FAN COMPANY, Kalamazoo, Mich.

You can Rely on...
CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • *IN CANADA:* Canada Fans, Ltd., 4285 Richelieu St., Montreal

Three Reasons Why

...Years of Trouble-Free Service

Cutaway view of DZ-60B breaker, showing one *Ruptor* unit, with bayonet-type movable contact in open position.

Ruptor unit in contact break position.

Ruptor unit in full closed position.

One **Few moving parts!**

Bayonet contacts (1) are the only moving parts of the *Ruptor* interrupting device.

Two **Easy inspection!**

Drop the tank, and the bayonet contacts are visible in open position. For access to the stationary contacts, one needs only to remove four bolts and cylindrical shell (2).

Three **Self-aligning and Self-cleaning contacts!**

Tulip and bayonet contacts (3) maintain high conductivity without readjustment or cleaning. Arc energy is minimized by efficient interruption within oil-filled *Ruptor* unit. This in turn contributes to long contact life and low oil deterioration.

In addition, a mechanically trip-free solenoid operating mechanism controls contacts of time-proved *Ruptor* interrupting devices. And pole unit mechanism is self-lubricated — completely enclosed — sealed from dust, dirt, corrosion.

In brief, Allis-Chalmers DZ breakers are built to assure years of dependable, trouble-free service.

Allis-Chalmers power circuit breakers are available in ratings from 2.5 to 230 kv, with interrupting capacities from 15,000 to 10,000,000 kva, to meet all industrial and power company requirements. For more information, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

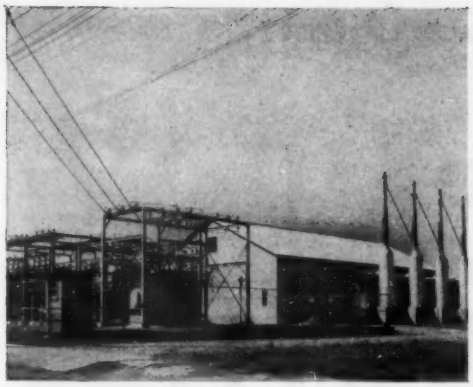
A-4057

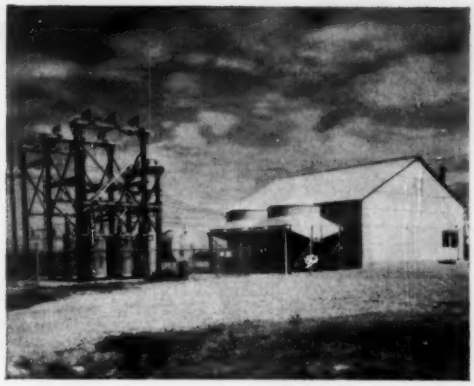
Ruptor is an Allis-Chalmers trademark.

TYPE	RATED KV	MINIMUM KV AT RATED KVA	RATED AMPS	KVA INT. CAPACITY
DZ-40B*	7.2	2.3	600	100,000
			1200	100,000
			2000	100,000
DZ-60B†	13.8	4.0	600	150,000
			1200	150,000
DZ-100B†	13.8	4.0	1200	250,000
DZ-200B†	13.8	6.6	1200	500,000
			2000	500,000

*Ask for Bulletin 71B6179. †Ask for Bulletin 71B6129.

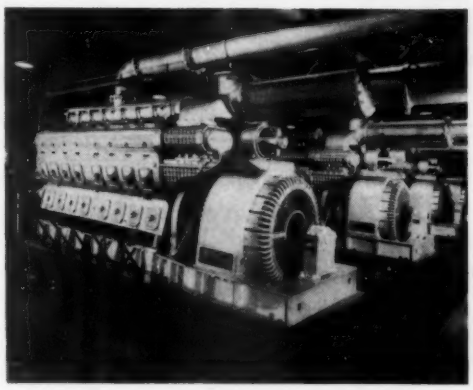
ALLIS-CHALMERS

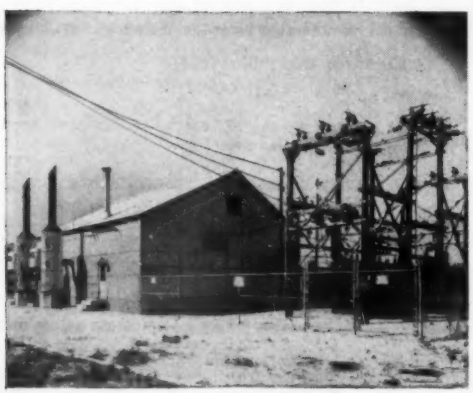




BE A SATISFIED CUSTOMER

For one customer alone, Pritchard has fulfilled contracts for 11 different diesel power installations. Such repeat contracts mean satisfied customers . . . are the best proof that Pritchard customers receive the design and construction skills, diesel know-how, and dependable services that are needed to produce modern, efficient installations.





Industry's Partner for Progress

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS

Dept. 388, 210 West 10th St., Kansas City 5, Mo.

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SERVING THE GAS, POWER, PETROLEUM AND CHEMICAL INDUSTRIES

High Efficiency Deaeration at *LOW COST* for Small and Medium Size Power Plants

Cochrane

*UNI-PAC DEAERATOR

- FACTORY ASSEMBLED
- COMPLETELY SELF-CONTAINED
- EASY TO INSTALL
- MINIMUM PIPING REQUIRED
- WIDE RANGE OF HEATER SECTIONS, STORAGE TANK AND ACCESSORIES TO MEET ANY PLANT REQUIREMENT
- GUARANTEED ZERO OXYGEN

COCHRANE CORPORATION — WATER ENGINEERS FOR 91 YEARS — 1863 - 1954

Here's the deaerator every small and medium-size plant has been waiting for!

Now for the first time you can get a ready-to-install deaerator that will give you high quality boiler feedwater at extremely low cost. The UNI-PAC DEAERATOR is guaranteed to deliver water with an oxygen content not to exceed 0.005 c.c. per litre (less than 7 p.p. billion)—generally recognized as zero oxygen!

*Trademark

The UNI-PAC DEAERATOR is designed for both right and left hand installation, and in a wide range of outlet and storage capacities. Accessory equipment is available to meet the conditions of operations peculiar to the plant and to obtain the results desired.

Publication 4643 contains complete details. Write today for your copy.

C100.2

COCHRANE CORPORATION
3106 N. 17th STREET, PHILADELPHIA 32, PA.

Please send me a copy of your Publication 4643 on the Cochrane UNI-PAC Deaerator.

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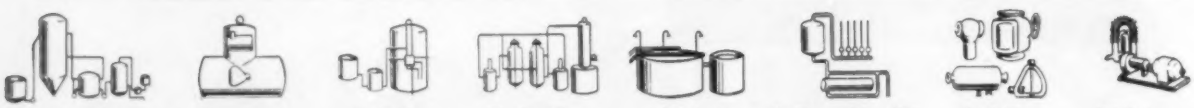
In Europe: Recuperation Thermique & Epuration, Paris
In Cuba: Laurence E. Daniel, Inc., Havana
In South America: Servicios Electricos, C.A. (S.E.C.A.) Caracas, Venezuela



Hot Process Softeners | Deaerators | Dealkalizers | Demineralizers | Reactors | Continuous Blow-Off | Specialties | C-B Systems

See for Yourself

BACK in engineering-school days I had a classmate who felt nothing but contempt for the practical side of engineering. *He* was going to be an *executive* and never get near the shop.

Just a while ago I met him and he *is* an executive. But he's also a changed man. Now he knows, from hard experience, that there's no substitute for direct, first-hand contact with the men and machines that make industry go.

His late-in-life endorsement of what first-class engineers and executives have known all along came to mind the other day when I read some news releases on the 1954 Power Show.

Why should today's engineers go to the Power Show? Or to any other exhibit for that matter? Their technical magazines bring them continuous reports on new equipment and methods. And equipment salesmen stand ready to add to this information at the drop of a hat.

Certainly this flow of product facts is useful, even indispensable. Yet a topnotch exhibit like the Power Show adds an invaluable dimension—the dimension of first-hand contact.

Those of you able to visit the Show will see the best of today's methods and machines in the flesh. And you'll see them under ideal conditions—in special displays designed to demonstrate unique engineering features, explain working principles, illustrate applications.

Even the best-edited new-products pages in an engineering magazine or the most energetic salesman can't bring such a display to your plant. For this kind of thing, the mountain can't be brought to you, you must go to the mountain.

And when you get there, you'll find another advantage. Displays of big companies will be manned by top technical-sales people, men able to answer the most penetrating questions you can throw at them. In the booths of smaller companies you'll often have a chance to talk to "the man" himself —the inventor of the device or the chief engineer who developed it.

There's still one more "plus"—a mighty big one even though it's intangible. By stepping out of your office or plant and going to take a look at what's new and exciting you become a *seeker* instead of a *receiver*. Because you take positive action to gather information, you'll absorb a lot more and put it to better use when you get back home to your plant.

All this adds up to a simple message: plan now to be at the 1954 Power Show. The time: December 2, 3, 4, 6, 7. The place: Commercial Museum, 34th and Spruce St, Philadelphia, Pa. We'll be there—stop in for a visit with us!

An important concerning

SAVINGS UP TO $3.00 PER TON CAN BE EFFECTED WITH THE KENNEDY PULVERIZED COAL FIRING SYSTEM

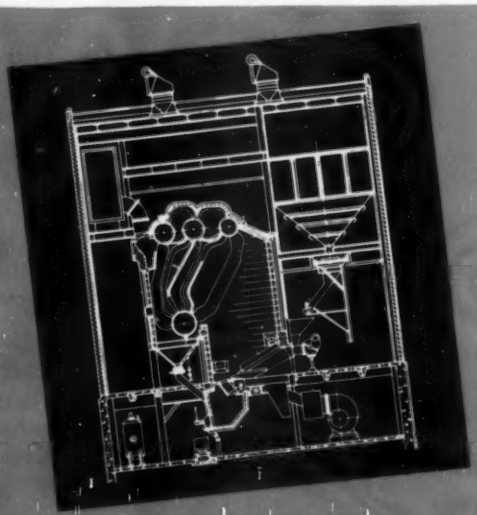
With the KVS Pulverized Coal Firing System you can give your steam plant a "lift" by burning the cheapest grades of coal and still obtain results in heat values obtained from the most costly fuel. Think of the savings in dollars this can mean!

The KVS Coal Firing System obtains maximum heat value from every ton of coal burned. No other system produces comparable results . . . no other system provides such drastic savings in coal costs.

A feature of the KVS Pulverized Coal Firing System is extremely fine pulverization . . . 85% to 90% through U. S. standard 200 mesh . . . making pulverized fuel instantly available to meet fluctuating loads with quick, flexible response to combustion control. The result: more heat to produce more power from any given quantity of coal.

The KVS system is air swept through large trunions so that 20% moisture can be liberated during pulverization. Coal completely carbureted, ready for combustion. Fuel reserves in the pulverizer available for instant response to steam demand. Any type coal, bituminous, anthracite, coke breeze, pulverized to super fineness. Tramp iron actually aids in pulverizing. We invite inquiries regarding the low operating and maintenance costs of this highly efficient Pulverized Coal Firing System.

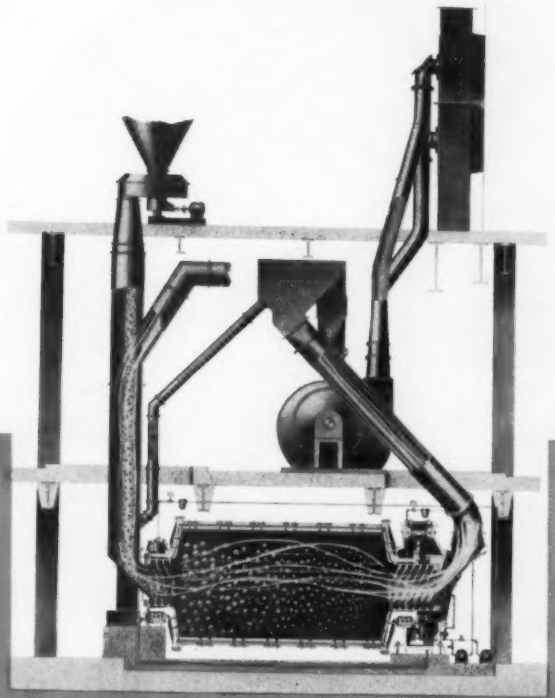
IT COSTS **LESS** TO OWN THE BEST



Before: Using premium coal on stokers

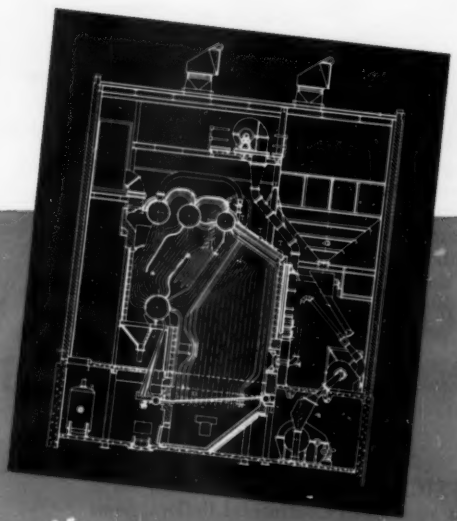
TWO PARK AVENUE, NEW YORK 16, N.Y. • FACTORY, DANVILLE, PA.

Message
Coal Costs



KVS. COAL FIRING SYSTEM

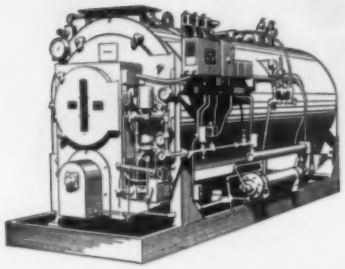
Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster and burners. Raw coal and pre-heated air up to 750°F enter one end of the pulverizer and leave the other end. Moisture in the coal is liberated during pulverization.



After: Using low price coal through pulverizers

KENNEDY-VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION



An Engineer Tells WHY Continental Boiler Tube-Sheets Have Long Service Life

"Pictured here is the rear tube-sheet of a packaged boiler, where the combustion gases at high temperature emerge from the furnace and sweep over the tube-sheet to enter the return tubes. Tube-sheet and tube ends are exposed to intense heat which may overheat the metal and cause serious damage.

"Tough problem . . . but the Continental features a simple solution:

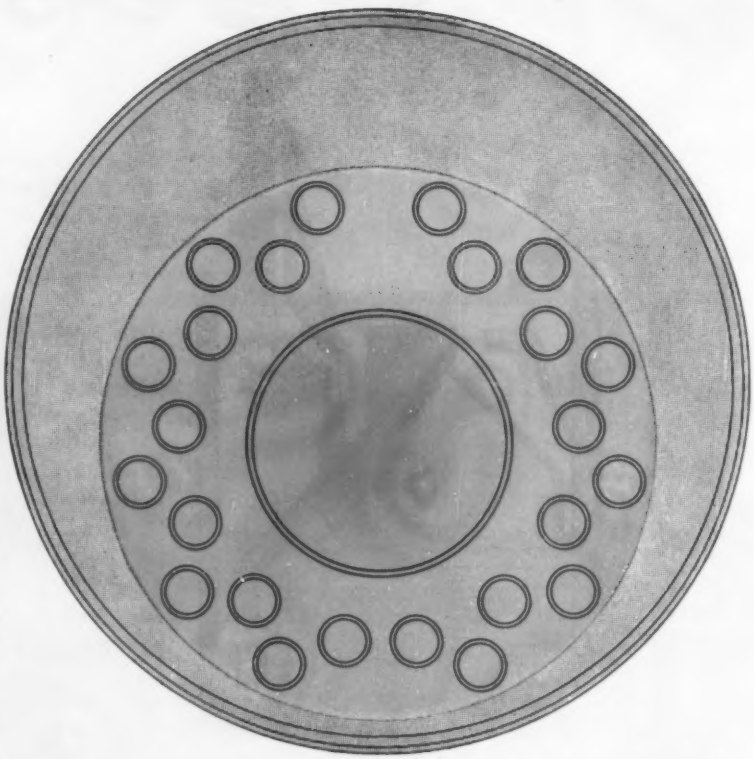
"(1) It provides equal flow of combustion gases to all return tubes so that all heating surfaces are equally effective.

"The Continental Boiler's two-pass design enables the hot combustion gases to transmit heat uniformly to the tube-sheet and tubes, thus making all surfaces equally effective.

"(2) The Continental Boiler provides adequate water circulation by proper arrangement of furnace and return tubes.

"It is essential that the large amount of heat carried to the tube-sheet and tube ends be quickly transferred to and absorbed by the boiler water. Sluggish circulation caused by close packing of return tubes may cause a heat block — with resultant overheating and damage to the metal.

"Note the symmetry of tube layout in the Continental Boiler. There is uniform distribution of heat over the entire tube-sheet . . . equal loading of all return tubes . . . free and balanced water circulation space — with single pass of return tubes."



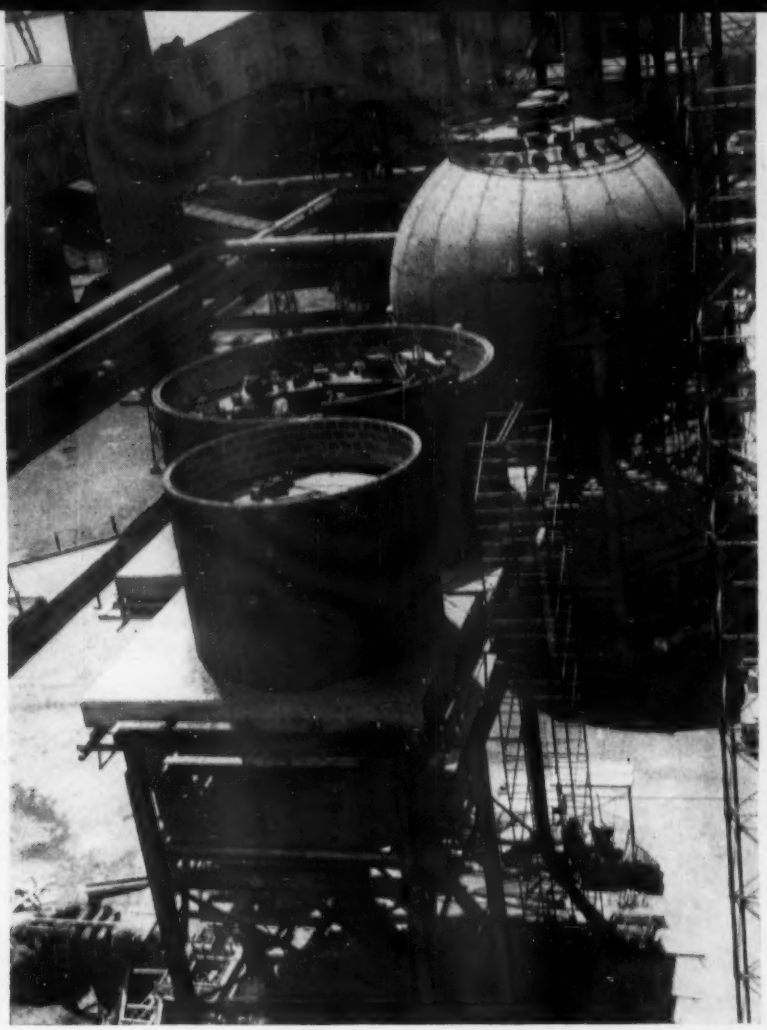
EFFICIENCY — guaranteed over 80% for all sizes of Continental Boilers, from 20 to 500 hp. Dependable, trouble-free operation — for steam heating at pressures from 15 to 250 pounds . . . or for hot water heating at low or high temperatures.

Write for Bulletins BE3 and BE4.

CONTINENTAL . . .
the boiler with the spinning gas technique

CONTINENTAL
Automatic Boiler
Manufactured by:
BOILER ENGINEERING & SUPPLY CO., INC.
Phoenixville, Pa.

Power
NOVEMBER 1954



FLYASH AND BOTTOM-ASH silos, foreground, can hold 600 and 150 tons of ash

At Ford's Rouge Power Plant:

Aerodynamic dust collectors team up with pneumatic ash handling to lick air pollution

By
L F O'REILLY
Project Engineer
Ford Motor Company

R H MILLS
Mechanical Engineer
Ford Motor Company

W J FADDEN JR
Project Engineer
The Kuljian Corporation

In planning an efficient and economical design for air-pollution control and ash handling, Ford and Kuljian engineers carefully studied all available types. Net result was a scheme best suited to the particular needs of Rouge Power Plant.

While conditions at your own plant may not exactly parallel Ford's you'll find much useful information here that can be widely applied.

Second of a series

For engineering facts and figures, turn page

CONE-TYPE dust collectors filter flyash from the flue gas in two stages

DUST COLLECTORS and soot hoppers on the roof of boiler No. 2. Soot hoppers flank the stack. Breeching, left foreground, exhausts flue gas downward to i-d fan

TABULATION OF DUST COLLECTORS

Boiler No.	Boiler capacity, lb per hr	Boiler press., psig	Steam temp, F	Flue gas		Gas temp F	Expected collector eff, %*	Expected press. drop in. wg
				lb per hr	cfm			
1	700,000	1400	750	969,000	337,000	400	86	1.0
2	600,000	250	650	821,000	275,000	375	92	0.97
3	700,000	1400	750	969,000	337,000	400	86	1.0
4	600,000	250	650	821,000	275,000	375	92	0.97
5	900,000	1400	925	1,180,000	394,000	365	86	1.0
6	600,000	250	650	821,000	275,000	375	92	0.97
7	900,000	1400	925	1,180,000	394,000	365	86	1.0
8	380,000	250	650	(Boiler to be replaced in near future)				

*Corrected to stack temperature

TABULATON of dust collectors gives basic design data for seven units. Low-pressure boiler No. eight is to be replaced soon. Collector will then be installed

Refined separation of flyash particles from flue gas and

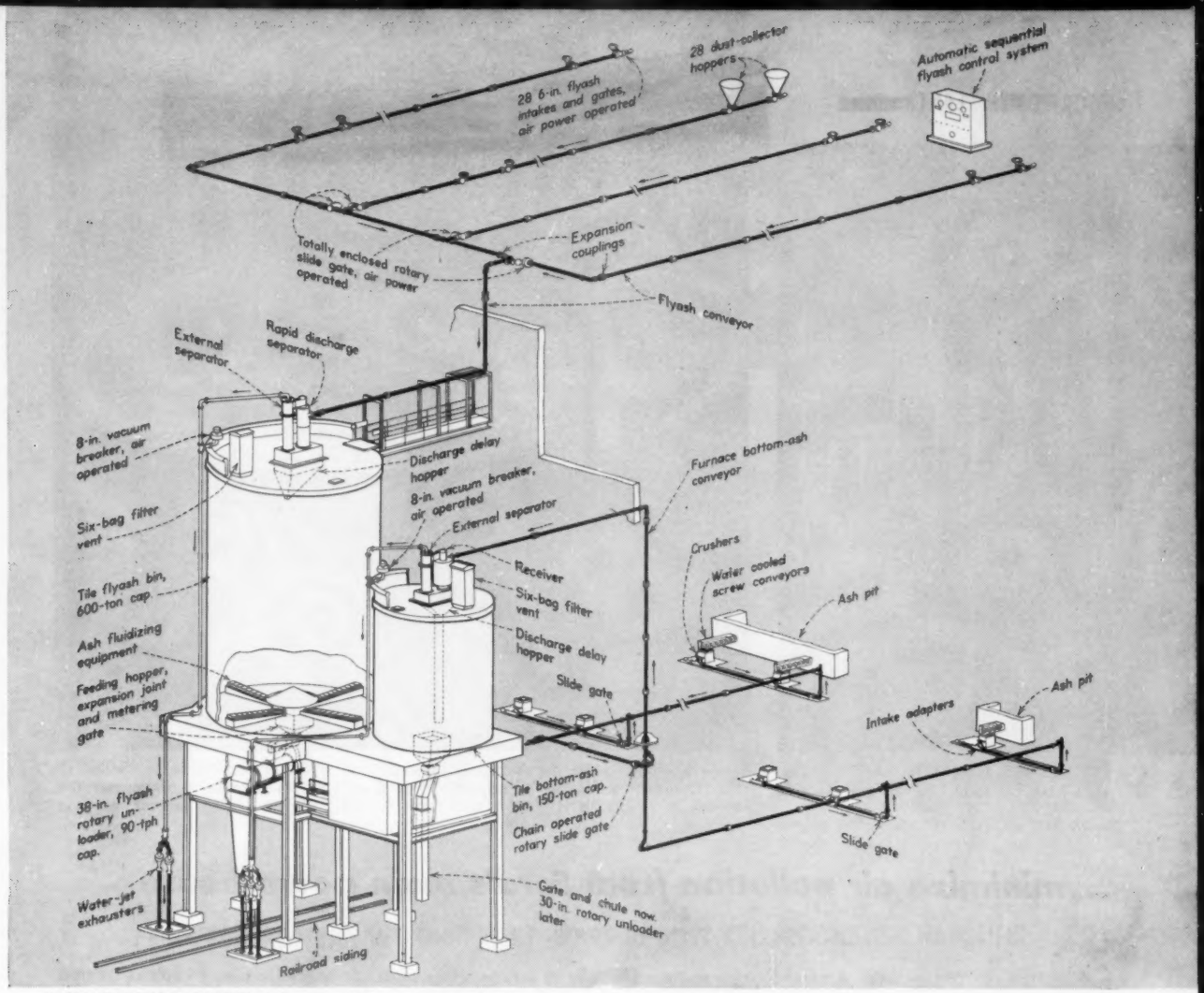
► IN THIS NEWEST and biggest modernization of the Rouge Power Plant, Ford engineers, fully cognizant of their company's responsibilities to the community, have given flyash collection careful consideration.

Old system. Before the present modernization program was considered, bottom ash was conveyed pneumatically from the discharge of two crushers on each steam generator. Ash was and will continue to be carried from ash hoppers to crushers by screw conveyors—one of the unique features of this plant. Conveying vacuum was originally produced by motor-driven blowers, bottom ash being deposited in a steel bunker within the building. With the new setup this ash bunker has been removed to provide space for the control room of new low-pressure unit No. 6 and future unit No. 8.

Present average rate of burning pulverized coal is about 2400 tons per day, with a peak of 2600 tons per day. In the future, 3000 tons per day may be expected. To get top economy, coal is supplemented with available blast-furnace and coke-oven gas.

For design purposes several assumptions were made, based on known data. Present coal has a heating value of 13,500 to 13,700 Btu per lb, with an ash content ranging from 7.5 to 9.5%. Using a design figure of 10% it was assumed that 20% of the ash would remain as bottom ash and 80% be carried with the flue gas as flyash. On this basis, bottom-ash conveyor will handle 60 tons per day and the flyash conveyor 240 tons per day—for the eight units.

Dust-collector design. After considering the various types available, mechanical collectors of aerodynamic-cone design were selected. Tabulation, above, gives capacities, expected pressure drops, and efficiencies for these units. Each boiler will be equipped with two complete flyash collectors connected to gas outlets of the two air preheaters serving each boiler. Each collector



ASH-HANDLING SYSTEM drawing shows conveyor piping arrangement from dust-collector hoppers and ashpits to storage bins. Water-jet exhausters pull vacuum necessary to convey ash to silos. This unit will actually serve all eight boilers

two vacuum systems for flyash and bottom-ash handling...

handles half of the flue gas at maximum boiler rating, based on a dust loading of two grains per cu ft. To achieve best dust-collector design a flyash particle-size distribution was estimated as follows: 30% smaller than 10 microns (one micron = 0.00004 in.) 20% between 10 and 20 microns, 10% between 20 and 30 microns, and the remainder larger than 30 microns. Average of several flyash samples taken supported these assumptions.

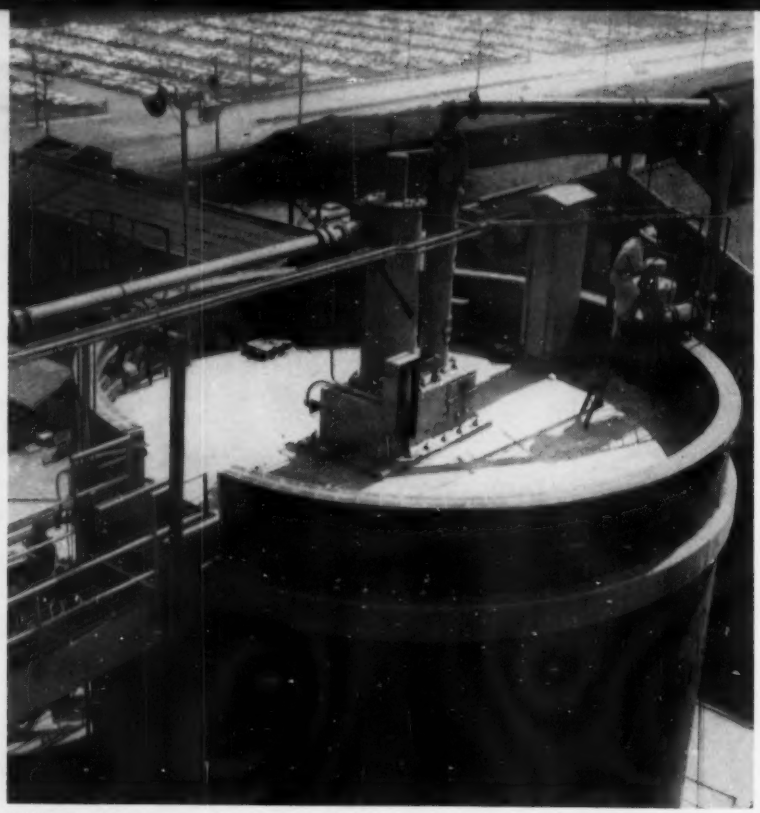
Photos, facing page, show internal and external views of dust collector with vertical cones. Flue gas enters cones through the large ends at bottom of the housing. The clean gas passes through louver openings in sides of cones and is exhausted. The flyash particles travel up the interior of the cones and are carried by about 5% primary gas into the secondary system. Secondary unit has four 40-in.-dia cyclones in which the dust is collected and discharged to a 900-cu-ft storage hopper. Secondary gas leaving cyclones passes through secondary fan and returns to collector inlet for recirculation.

Blast-furnace-gas firing results in higher draft loss than when firing pulverized fuel, but since there is no flyash with gas firing, the dust-collector bypass dampers may be opened, thereby reducing load on the induced-draft fans.

Collector operation. Critical point here is possibility of flyash depositing on cone surface when condensation occurs. So when starting up a boiler, bypass dampers are opened until flue-gas temperature reaches 280 F. Further, a motor-operated rapper with each collector insures that no wet flyash forms a crust on the cones. When unit starts up, rapper operates at 10-minute intervals. After that, as a precaution against plugging, cones are rapped 5 to 15 seconds every two hours.

Bottom-ash handling. This is a pneumatic system, shown in drawing above. Six-in. conveyor takes bottom ash from crushers on all boilers and discharges

EXHAUSTERS for flyash bin are accessible from platform. Sumps are separate



FLYASH BIN closeup shows rapid-discharge and external separators in center on roof. Operator on ladder is adjusting the 8-in. vacuum breaker in exhauster line

...minimize air pollution from Ford's main powerhouse

to a 150-ton tile storage silo. Arrangement calls for manual operation with 11 tons per hour average conveyor capacity (the rate from near boilers is 14 tph, from far units 8 tph). However, actual capacity is limited by existing 5-tph crushers. A rotary dustless unloader has been relocated under the new storage silo.

Unique watercooled ash screw conveyors and crushers on all boilers are interlocked. Thus, if bottom-ash conveyor is overloaded, the screw conveyor and crusher in operation at that instant stop. Interlock also operates this way when vacuum discharge of ash from receiver to storage silo is interrupted.

Flyash handling. In engineering this phase of the job, Ford and Kuljian engineers determined that plant needs would best be served by an entirely separate system to handle flyash from the new dust collectors. Drawing, p 75, also shows hookup. Except for the common supporting structure there is no connection to adjacent bottom-ash silo. This permits sale of uncontaminated flyash, a gain that will pay for the additional complexity of the system. Also, new rotary dustless unloader discharges to a truck or to a railroad car.

Flyash intake operation is by compressed-air cylinder. Automatic sequential system provides control. Sequence consists of emptying all collection points, skipping any units not in service, and shutting down. Control panel includes vacuum recorder, indicating system performance, time spent at each hopper and in service. Panel also includes drum to indicate which intake is open.

Flyash is pneumatically conveyed through centrifugally-cast chrome-alloy pipe. It is separated from conveying air by a primary separator on the flyash storage silo. Separator discharges through a power-operated gate. Secondary separator on the silo collects the remaining fines. Full-load conveying capacity is 14 tph from far boilers, 26 tph from near boilers.

Discharge delay hopper prevents build-up of silo pressure by insuring proper loading of silo. Fluidizing equipment, shown in drawing, controls emptying of silo and uniform feeding of the rotary unloader. Also, the fluidizers give the silo more active storage capacity and increase the rotary dustless unloader capacity from 60 tph to 100 tph.

Vacuum equipment. Before deciding whether to use steam or mill water for necessary vacuum in ash-conveying systems, economic studies were made. They pointed up about a $10,000 yearly saving in favor of the water system.

Two 6-in. water exhausters for the flyash system and three for the bottom-ash pull the necessary vacuum. These jet-type units discharge to separate sump pits next to the silo structure.

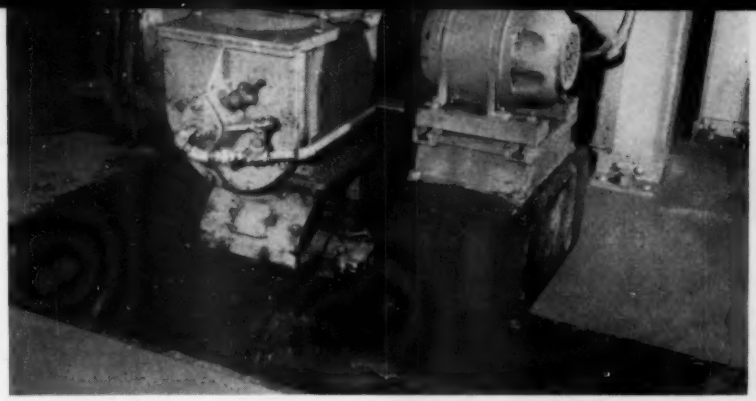
Each sump pit is covered with heavy-duty grating so exhaust air is vented freely. Each sump pit drains to a common manhole via a 30-in. concrete pipe. Grating over the manhole vents any entrained air. Finally, water is piped to circulating-water tailrace from the powerhouse. Flow is 3000 gpm at 70 psi—for each of the two systems.

Structural problems. Rouge Power Plant was originally designed in 1920 for boilers with 200,000-lb-per-hr capacity each—without economizers or dust collectors. In spite of very conservative original design, keeping the total weight of boiler and accessory units within limits, dictated by the allowable stresses of the existing build-

ing steel, was no simple task. Considerable structural steel and an additional floor were added to the building. Galbestos siding kept weight down to a minimum without sacrifice of architectural harmony. This lightweight siding material was also used for the unloader room below the ash-storage silos.

Piling arrangement for the silo supporting structure presented a tricky problem. The silo structure not only had to be located over the existing railroad siding, but also had to clear unused and uncapped existing piling next to the powerhouse foundation mat. This meant driving some of the new piling between existing piling. New piling can be loaded to 75 tons per pile, whereas existing pile capacity was 15 tons—not strong enough for the job.

In connecting the 30-in. discharge from water exhausters to the 12 2/3-ft tailrace the choice was between cutting directly into the tailrace and discharging into an existing manhole over it. Because the tailrace was built of 18-in. keyed concrete block and was under about 10-ft static head, cutting into it seemed likely to cause its collapse. So at the expense of an additional run of pipe, exhauster water is discharging into the existing manhole.



WATERCOOLED bottom-ash screw conveyor, ash crusher and drive. Bottom-ash piping, running in trench in front of ashpit, is chrome alloy, centrifugally cast

FLYASH SOOT HOPPERS and ash piping run above boiler roof. Air-operated sequential control valve, in foreground, functions automatically from control panel

PRINCIPAL POWER-PLANT EQUIPMENT—PART II: DUST COLLECTION, ASH HANDLING

Rouge Plant, Power House No. 1, Ford Motor Company, Dearborn, Mich.

Dust collectors, 6 .....The Green Fuel Economizer Co, Inc
Aerodyne cone-filter type, 2 each for units 2, 4 and 6. 275,000 cfm total at 375 F, sixteen 22-in.-dia cones in each collector. 92% efficiency, 0.97-in. wg press. drop, guaranteed flyash emission not more than 0.2 grains per cu ft. Each collector furnished with: Chain-type rapper driven by ¾-hp Sterling Slo-speed motor, 800-cu-ft flyash storage hopper, 4 cyclones, Clarage Fan Co secondary-air fan, handling 5% of collector capacity, direct driven by General Electric 1200-rpm 220/440-volt TEFC motor, multiple-leaf louver-type bypass dampers with Bailey Meter air-operated control drive, remote manual control

Dust collectors, 4 .....The Green Fuel Economizer Co, Inc
Aerodyne cone-filter type, 2 each for units 1 and 3; 337,000 cfm total at 400 F, sixteen 24¾-in.-dia cones in each collector, 86% efficiency, 1.0-in. wg press. drop, guaranteed flyash emission not more than 0.2 grains per cu ft. Each collector furnished with: Chain-type rapper driven by ¾-hp Sterling Slo-speed motor, 910-cu-ft flyash storage hopper, 4 cyclones, Clarage Fan Co secondary-air fan, 9130 cfm at 7.0-in. wg static press., direct driven by General Electric 25-hp 1200-rpm 220/440-volt TEFC motor, multiple-leaf louver-type bypass dampers with Bailey Meter air-operated control drive, remote manual control

Dust collectors, 4 .....The Green Fuel Economizer Co, Inc
Aerodyne cone-filter type, 2 ea for units 5 and 7. 394,000 cfm total at 365 F, eighteen 24¾-in.-dia cones in each collector, 86% efficiency, 1.0-in. wg press. drop, guaranteed flyash emission not more than 0.2 grains per cu ft. Each collector furnished with: Chain-type rapper driven by ¾-hp Sterling Slo-speed motor, 910-cu ft flyash storage hopper, 4 cyclones, Clarage Fan Co secondary-air fan handling 5% of collector capacity, direct driven by General Electric 1200-rpm 220/440-volt TEFC motor, multiple-leaf louver-type bypass dampers with Bailey Meter air-operated control drive, remote manual control

Ash-handling system .....United Conveyor Corp
Automatic flyash-handling system, pneumatic, 20-tph avg capacity. Nuvatrol control panel, sequence switch, visual-position indicator, recording vacuum gage, air- and water-press. gages, timers, vacuum switches, selector switches, 4 pneumatic flyash intakes per boiler, 4 automatic check valves (air intakes), 6-in. centrifugally cast chrome-alloy pipe, solenoid valves to operate flyash intakes, primary rapid discharge separator with power-operated discharge gate, external secondary separator with counterweighted-type discharge gate, discharge delay hopper, bin fluidizers. Bottom-ash-handling system, pneumatic, manually operated, 11-tph avg capacity, 6-in. centrifugally cast chrome-alloy pipe, 2 automatic check valves (air intakes), primary rapid-discharge separator with power-operated discharge gate, external secondary separator with connterweighted-type discharge gate, discharge delay hopper. Flyash storage silo, 600-ton (40 lb per cu ft) gross capacity, 27 2/3-ft ID × 29-ft OD × 50-ft inside height, tile, inside bin ladder, pressure-relief door. Bottom-ash storage silo, 150 ton (50 lb per cu ft) gross capacity, 17-ft ID × 18-ft OD × 26 2/3-ft inside height, tile, inside bin ladder, pressure-relief door. Flyash rotary unloader, 100 tph, 38 in., driven by 10-hp totally enclosed motor, rotary vane feeder driven by 1-hp totally enclosed motor, swinging chute with cable, winch and sheaves. Bottom-ash rotary unloader, existing 30 in., relocated. Vacuum-producing equipment, 5 Hydroveyor water-jet exhausters (3 bottom ash, 2 flyash) 2 vacuum breakers pneumatically operated (1 per system)

Piling and foundations .....Spencer, White & Prentice, Inc

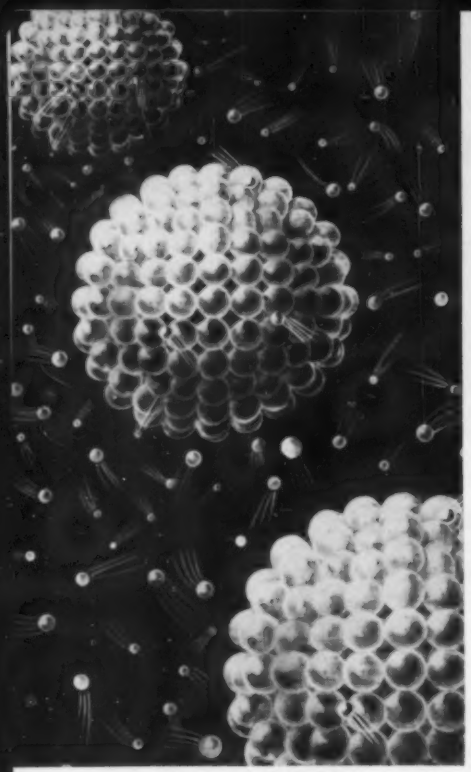
Electrical wire and lighting .....Harlan Electric Co

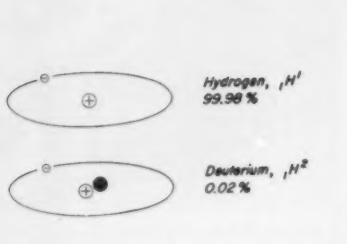
Motor-control center, 1 .....General Electric Co

Piping .....Lorne Plumbing & Heating Co

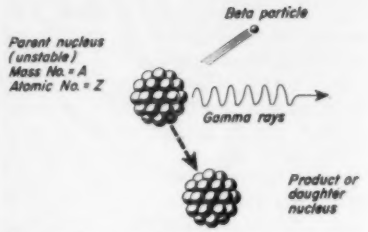
Corrugated siding and louvers .....H H Robertson Co

Engineers and constructors .....The Kuljian Corporation

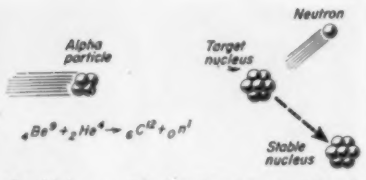




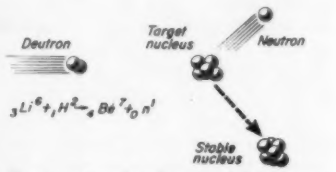
1 Atmospheric hydrogen contains only 0.02% of deuterium, called heavy H



2 Artificial radioactive isotopes emit radiations to regain a stable state



4 Alpha particle bombardment of beryllium led to the discovery of neutrons



5 Deuteron bombardment of lithium releases high-energy neutron quickly

Our modern scientists have achieved the age-old dream of the alchemist of transmuting one substance into another. We have come so far along this road that now . . .

Man-made reactions create new elements

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors Inc*

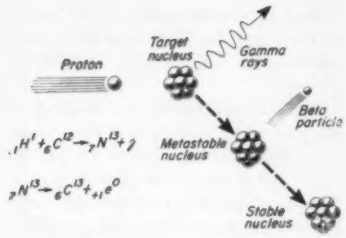
► IN THE FIRST FOUR PARTS of this study course we learned about the atom: its structure, the constituent particles and their behavior in nature. Now let us go into a physicist's laboratory and see what use he makes of these particles—how he handles them and the results.

Nuclear vs chemical reactions. Study of nuclear reactions increases our knowledge of matter, and discovery of the neutron in 1932 led us to the release of nuclear energy. Just as one compound reacts with another in a chemical laboratory, atomic nuclei react with other nuclei or their particles. As you might expect, the actions are quite different in the two.

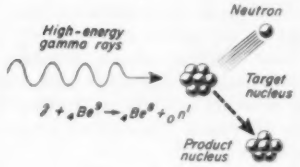
Chemical reactions involve changes in arrangement of electrons of atoms or molecules, which converts very small amounts of mass into energy. In contrast, *nuclear reactions* involve the effect of nuclear particles like neutrons, protons, electrons and gamma rays on the nuclei of atoms. These reactions convert relatively large amounts of mass into energy when compared to chemical reactions.

The rate at which atomic nuclei and nuclear particles react is normally far less than for chemical reactions involving atoms and molecules because: (1) The small diameter of the nucleus (10^{-12} cm) compared to the atom diameter (10^{-7} cm) means that nuclear collisions causing reactions occur less often than collisions between the much larger atoms and molecules. This is easy to see when we realize that the atom diameter is 10,000 times greater than the nucleus diameter. (2) Repulsion forces between two nuclei or a nucleus and charged particle exist because of the positive charges they carry. As the two nuclei must approach each other within 10^{-12} cm before they can react, the repulsion energy that must be overcome is very large, especially for nuclei with high atomic number.

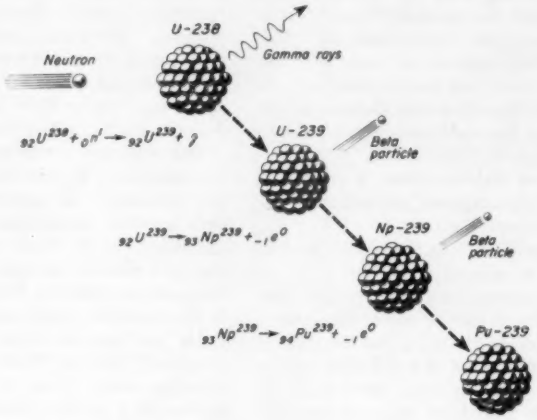
The reluctance of nuclear particles to interact can be overcome by:



3 High-speed proton, penetrating repulsion-force "barrier," can enter atom



6 Gamma rays (no mass) can knock protons and neutrons out of nuclei



7 Bombarding U-238 with a neutron produces fissionable plutonium after several intermediate nuclear reactions

1. *Thermonuclear reaction.* This occurs where a temperature of several million degrees is achieved and nuclei have enough kinetic energy to overcome their mutual electrostatic repulsion. This type of reaction occurs on the sun and stars and represents their energy source.

2. *Acceleration of charged particles* like protons or alpha particles. This is done by devices, such as the electrostatic generator, cyclotron, betatron, synchrotron, etc, to the point where the particles acquire enough energy to cause nuclear reactions when they contact a "target nucleus."

Transmutation process. The particle accelerators, mentioned above, have caused hundreds of different nuclear reactions involving nearly all the known elements. These reactions usually result in the element being bombarded by nuclear particles converting into another element or isotope. That is, the element is transmuted into another element.

To understand this transmutation process let's examine the mechanics of a typical nuclear reaction: (1) A nuclear particle, such as a proton, neutron or alpha particle, called the *incident particle* or projectile, is hurled at and strikes an atomic nucleus known as the *target nucleus.* (2) Reaction between the target nucleus and the incident particle forms a *compound nucleus,* which includes them both. That is, the incident particle enters and becomes part of the target nucleus. (3) The compound nucleus has both the kinetic energy and the binding energy of the bombarding particle. This "excess energy" causes the compound nucleus to become unstable. The compound nucleus eventually disintegrates in an effort to become stable.

Compound nucleus. Formation of the compound nucleus can be given by the equation:

Target nucleus + incident particle
→ compound nucleus

Particles commonly used to initiate nuclear reactions include:

Particle	*Symbol*
Proton	P or $_1H^1$
Deutron	d or $_1H^2$
Alpha particle	α or $_2He^4$
Neutron	n or $_0n^1$
Gamma ray	γ

Some of these atomic projectiles can be obtained from natural sources, such as naturally radioactive elements (pp 93-95, Sept 1954, POWER) or by various laboratory methods. Charged particles like protons, deutrons and alpha particles can be accelerated until they have kinetic energies of a million electron volts or more before smashing into the target atoms. Charged particles must have high energies to penetrate the "barrier" raised by the electrostatic forces of repulsion and to enter the nucleus of atoms.

Atomic projectiles. As shown by its symbol $_1H^1$ the proton has a single unit positive charge and a mass of one. This is identical with the nucleus of a hydrogen atom. In other words, we can say a proton is a hydrogen atom stripped of its electron.

The deutron is a "heavy hydrogen" nucleus consisting of a neutron in addition to the proton. It has an atomic number of one and a mass number of two, or $_1H^2$. Atmospheric hydrogen contains 99.98% of the lighter isotope $_1H^1$ and only 0.02% of the heavier isotope $_1H^2$, Fig. 1.

The heavy isotope, *deuterium,* may be separated by prolonged electrolysis of water wherein the water is decomposed and the deuterium concentrated. The deuterium nucleus, a deutron, is a particularly effective projectile for causing nuclear transmutation. A relatively small amount of energy can split it into a neutron and a proton. This low binding energy can mean that as the deutron approaches a nucleus the electrostatic repulsion of the positive charges tends to force the proton away without affecting the neutron. The latter can then enter the nucleus since there is no "barrier" affecting it.

The alpha particle (p 93, Sept 1954, POWER) is a helium nucleus consisting of two neutrons and two protons giving it an atomic number of 2 and a mass number of 4, $_2He^4$. This large positive charge means that an alpha particle requires much more energy to penetrate the target nucleus and cause a reaction

than does a proton or deutron with its single positive charge.

The neutron carries no electrical charge and has a much greater chance of interacting with the target nucleus because of the absence of an electrostatic repulsion "energy barrier." This means that neutrons at even very low energy levels can easily penetrate the nucleus. This is a very definite advantage that neutron reactions have over charged-particle reactions.

Nucleus disintegration. A compound nucleus disintegrates according to the following equation:

Compound nucleus → product nucleus + ejected particle

The compound nucleus resulting from bombardment can be one of the natural, stable species of nuclei, but more likely it will be an atom of a different type in a highly unstable state because of the energy it picked up from the particle. This instability means that the compound nucleus will disintegrate. It is radioactive and will emit energy in the form of particles or radiation, or both, in an attempt to reach stability. The resultant or product nucleus may in turn be radioactive and will also decay. This process continues until the nucleus changes to a stable type.

The particle emission can be a single nucleon (proton or neutron) or, if sufficient energy was carried in by the bombarding particle, can be a combination of nucleons escaping. If the excess energy in a compound nucleus is not enough to expel a nucleon, some or all of it may be emitted as gamma radiation, leaving a more stable residual nucleus. When an incident particle unites with the target nucleus, the compound nucleus exists for a fantastically short time, only 10^{-14} second, before disintegration takes place.

The majority of artificial radioactive isotopes decay by emitting either negative (electron) or positive (positron) beta particles accompanied by gamma radiation, Fig. 2. Both types of radiation are classed as beta activity with the positron differing from the electron in electrostatic charge only. Both particles are emitted from the nucleus. Scientists theorize that positive beta emission results from the change of a proton to a neutron with the positron being emitted. This decreases the atomic number by one. In a negative beta emission a neutron changes to a proton and electron with the electron being emitted. This increases the atomic number by one. Summarizing:

		Nuclear change in:	
Beta particle	*Symbol*	*atomic number*	*mass number*
Electron	$_{-1}e^0$	+1	0
Positron	$_{+1}e^0$	−1	0

Artificially radioactive substances differ from naturally radioactive elements in that they seldom emit alpha particles as the latter do. Note also that positron emission is unknown in natural substances.

Typical reactions. In dealing with nuclear reactions, a nuclear equation describes what takes place, for example:

$$_3Li^7 + {}_1H^1 \rightarrow {}_4Be^8 + \gamma$$

means a proton bombarding natural lithium produces a nuclide, beryllium-8, atomic number and mass number of which both are one unit higher than the target nucleus and which emits gamma radiation. This type of reaction is often used to produce gamma radiation for experimental purposes.

Note that the atomic numbers and mass numbers balance on both sides of the equation just like a chemical equation. Frequently a shorter notation is used, such as:

$$Li^7(P,\gamma)\ Be^8$$

The target nucleus is written first, with its mass number, then the incident particle and emitted particle in parenthesis, followed by the residual nucleus.

Any type of reaction may be described by the particle symbols given on p 79. Thus, a (P,γ) reaction is one in which the target nucleus is bombarded with protons and results in release of gamma radiation. A $(\alpha, 2n)$ reaction is one in which high-energy alpha particles bombarding a nucleus cause the explusion of two neutrons.

The table shows some of the many types of reactions possible in the laboratory. Let us take a more detailed look at specific examples of each type of basic reaction.

Proton bombardment. Fig. 3 shows a proton being hurled into a target nucleus of carbon. This releases gamma radiation and produces a nucleus of nitrogen-13 in a metastable state (not the most stable possible under the given conditions, but stable enough to have an independent existence). The N-13 is radioactive and emits a beta particle to reach a stable state as a carbon-13 isotope.

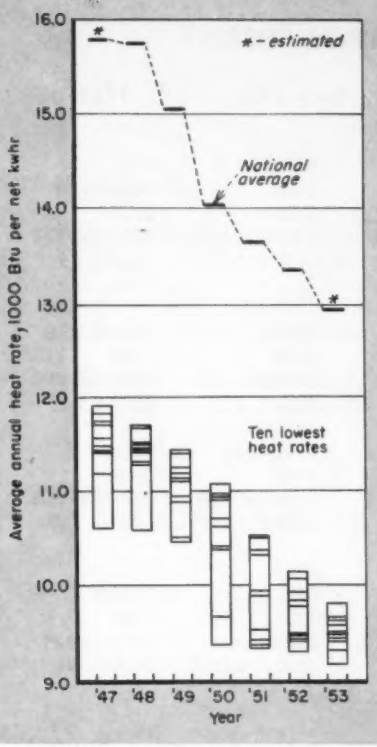
Alpha-particle bombardment. The (α, n) transmutation shown in Fig. 4 led to the discovery of the neutron back in 1932. It frequently provides a laboratory source of neutrons. The alpha particles used as projectiles may be obtained from radium, which is naturally radioactive (p 94, Sept 1953, POWER.) The beryllium being bombarded is transmuted into carbon-12 with the emission of a neutron.

Deutron bombardment. In Fig. 5 a bombarding deutron enters the lithium nucleus. A neutron is ejected from the compound nucleus, which changes into

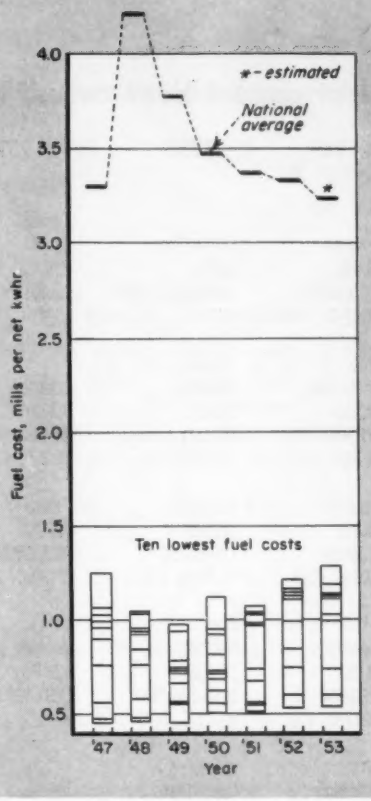
(Continued on page 198)

Typical examples of nuclear reactions

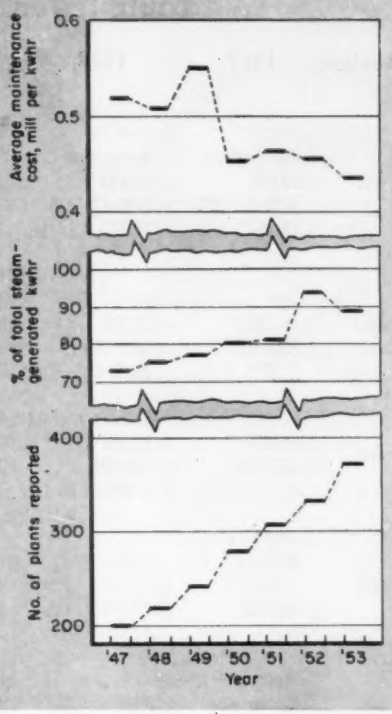
Type of reaction	*Projectile*	*Emitted particle*	*Change in: atomic number*	*Change in: mass number*	*Typical reaction*	*Usual radioactivity of product nucleus*
	Proton					
p, γ	$_1H^1$	γ	+1	+1	$_6C^{12} + {}_1H^1 \rightarrow {}_7N^{13} + \gamma$	$_{+1}e^0$
p, n	$_1H^1$	$_0n^1$	+1	0	$_{11}Na^{23} + {}_1H^1 \rightarrow {}_{12}Mg^{23} + {}_0n^1$	−
p, α	$_1H^1$	$_2He^4$	−1	−3	$_9F^{19} + {}_1H^1 \rightarrow {}_8O^{16} + {}_2He^4$	none
p, d	$_1H^1$	$_1H^2$	0	−1	$_4Be^9 + {}_1H^1 \rightarrow {}_4Be^8 + {}_1H^2$	α
	Neutron					
n, γ	$_0n^1$	γ	0	+1	$_{48}Cd^{113} + {}_0n^1 \rightarrow {}_{48}Cd^{114} + \gamma$	none
n, p	$_0n^1$	$_1H^1$	−1	0	$_7N^{14} + {}_0n^1 \rightarrow {}_6C^{14} + {}_1H^1$	$_{-1}e^0$
n, α	$_0n^1$	$_2He^4$	−2	−3	$_8O^{16} + {}_0n^1 \rightarrow {}_6C^{13} + {}_2He^4$	none
n, 2n	$_0n^1$	2_0n^1	0	−1	$_6C^{12} + {}_0n^1 \rightarrow {}_6C^{11} + 2_0n^1$	$_{+1}e^0$
	Alpha particle					
α, p	$_2He^4$	$_1H^1$	+1	+3	$_7N^{14} + {}_2He^4 \rightarrow {}_8O^{17} + {}_1H^1$	none
α, n	$_2He^4$	$_0n^1$	+2	+3	$_5B^{10} + {}_2He^4 \rightarrow {}_7N^{13} + {}_0n^1$	$_{+1}e^0$
	Deutron					
d, p	$_1H^2$	$_1H^1$	0	+1	$_{11}Na^{23} + {}_1H^2 \rightarrow {}_{11}Na^{24} + {}_1H^1$	$_{-1}e^0$
d, n	$_1H^2$	$_0n^1$	+1	+1	$_6C^{12} + {}_1H^2 \rightarrow {}_7N^{13} + {}_0n^1$	$_{+1}e^0$
d, α	$_1H^2$	$_2He^4$	−1	−2	$_8O^{16} + {}_1H^2 \rightarrow {}_7N^{14} + {}_2He^4$	none
	Gamma ray					
γ, p	γ	$_1H^1$	−1	−1	$_{12}Mg^{25} + \gamma \rightarrow {}_{11}Na^{24} + {}_1H^1$	$_{-1}e^0$
γ, n	γ	$_0n^1$	0	−1	$_4Be^9 + \gamma \rightarrow {}_4Be^8 + {}_0n^1$	α



1 New low-heat-rate stations pull down national average annual heat rate



2 While lowest fuel-cost plants drift higher, national average costs drop



3 Large number of new units help to force down average maintenance cost

Zooming load growth of our electric utility systems, coupled with rising costs, continues to push plant designers into new areas of thinking and practice. So when looking over the field we find that . . .

Plant-design advances set new records

By B G A SKROTZKI, *Associate Editor*

► THE GENERAL ACCEPTANCE of high steam conditions and the wide application of reheat to many of our new central-station steam plants are dethroning some long-time champion performers. From 1935, *Port Washington* of the Wisconsin Electric Power Co held the lowest heat rate for a period of 14 years. But in 1949, this station dropped back to second place after *Sewaren* of Public Service Electric & Gas Co. In 1950, *Port Washington* dropped to fourth place; in 1951, to 7th place; and in 1952, it dropped out of the race for the best ten heat-rate performers.

Table I (p 82) lists the central stations with the ten best heat rates for each of the years 1947 to 1953. For many of the newer plants, the first year they appear represents less than a full year's operation. Since "normal" maintenance needs usually do not appear until after several years running, the production costs shown in mills per kwhr, are probably on the low side. These production costs (the last figure in each block) *do not* include the fixed charges for power-generation facilities.

Fig. 1, above, compares the ten lowest heat rates, listed in Table I, with the national average heat rate for steam-electric central stations. Effect of the large new units on the average heat rate is quite marked. Average size of new units during the period shown has grown from about 60 to almost 100 mw. The new units usually run on the base of the system load curve, relegating older equipment to peak-load and standby status. Of course, during the present rapid expansion of load the older plants are not completely dis-

(*Text continued on page* 84)

Table I: Ten best annual heat rates, 1947 to 1953

Rank	1947	1948	1949	1950	1951	1952	1953
1st	Port Washington † 10,600 1230-850/850 28.45-C, 3.63	Port Washington 10,588 1290-875/875 33.8-C, 4.17	Sewaren 10,437 1500-1050 27.62-O, 3.40	Philip Sporn 9,378 2080-1050/1000 15.76-C, 2.00	Tanners Creek 9,354 2000-1050/1000 17.81-C, 2.27	Tanners Creek 9,303 2000-1050/1000 18.65-C, 2.27	Kanawha 9,170 2075/1050/1050 21.27-C, 2.98
2nd	Tidd 11,190 1300-925 11.22-C, 1.71	Mystic 11,293 1200-950 38.20-C, 5.33	Port Washington 10,510 1380-900/900 31.30-C, 4.02	Schiller 9,672 Mercury-steam 31.5-O, 3.87	Schiller 9,379 Mercury-steam 35.3-O, 4.33	Dunkirk 9,430 1450-1000/1000 30.44-C, 3.35	Tanners Creek 9,329 2000-1050/1000 18.88-C, 2.20
3rd	Mystic 11,424 1200-950 33.05-C, 5.00	Lieberman 11,326 800-900 7.50-G, 1.28	Russell 10,892 1250-950 30.3-C, 4.13	Sewaren 10,389 1500-1050 30.53-O, 3.61	Philip Sporn 9,418 2000-1050/1000 18.69-C, 2.33	Philip Sporn 9,432 2000-1050/1000 18.98-C, 2.26	Albany 9,418 1492-1000/1000 34.87-C, 3.69
4th	John C Weadock 11,443 800-900 26.9-C, 3.44	Cliffside 11,426 1250-950 32.41-C, 4.44	O H Hutchings 10,951 1250-950 31.27-C, 3.87	Port Washington 10,405 1450-900/900 30.27-C, 6.71	Dunkirk 9,540 1450-1000/1000 29.6-C, 3.26	Schiller 9,492 Mercury-steam 35.65-O, 4.51*	Schiller 9,454 Mercury-steam 33.30-O, NR
5th	Bryce E Morrow 11,489 800-900 31.2-C, 3.96	Tidd 11,427 1375-925 13.55-C, 2.09	Port Jefferson 11,116 1250-950 34.2-O, 4.72	Dan River 10,621 1250-950 29.52-C, 3.40	Titus 9,886 1450-1000/1000 33.56-C, 3.64	J R Whiting 9,495 1450-1000/1000 29.37-C, 3.44	Dunkirk 9,510 1450-1000/1000 30.53-C, 3.39
6th	Riverside 11,571 850-900 27.49-C, 3.82	Bryce E Morrow 11,439 800-900 35.9-C, 4.51	B C Cobb 11,143 850-900 31.0-C, 3.98	O H Hutchings 10,708 1450-1000/1000 29.26-C, 3.60	W S Lee 9,954 1250-950/950 29.57-C, 3.29	Danskammer 9,794 1650-1000/1000 33.26-C, 4.11	J R Whiting 9,540 1480-1000/1000 29.31-C, 3.15
7th	New Castle 11,706 800-900 18.11-C, 2.90	New Castle 11,509 800-900 20.59-C, 3.08	Tidd 11,201 1375-925 15.03-C, 2.18	Russell 10,941 1250-950 31.8-C, 4.40	Port Washington 10,329 1450-900/900 30.64-C, 4.08	Titus 9,840 1450-1000/1000 34.32-C, 3.78	Philip Sporn 9,594 2000-1050/1000 19.36-C, 2.23
8th	Cliffside 11,753 825-900 27.20-C, 3.92	John C Weadock 11,513 800-900 31.8-C, 3.94	Watts Bar 11,260 850-900 24.68-C, 3.41	Potomac River 10,949 850-925 31.77-C, 3.98	O H Hutchings 10,372 1450-1000/1000 27.58-C, 3.29	W S Lee 9,941 1250-950/950 30.26-C**, 3.24	St. Clair 9,630 1850-1000/1000 28.93-C, 4.72
9th	Harbor 11,830 878-915 20.7-O, 3.50	Riviera 11,686 850-900 46.0-O, 6.08	White River 11,405 850-900 22.70-C, 3.47	Oswego 10,979 1250-900 29.6-C, 3.76	Russell 10,515 1250-1000 30.6-C, 4.03	New Johnsonville 10,086 1450-1000 21.34-C, 2.66	Eastlake 9,661 1850-1050/1000 28.80-C, 3.82
10th	Chesterfield 11,921 850-900 29.79-C, 4.25	Riverside 11,720 850-915 31.99-C, 4.39	Cliffside 11,442 1250-950 31.82-C, 4.31	Lumberton 11,093 1250-950 33.36-C, 4.13	Goldsboro 10,518 1250-955 33.91-C, 3.98	Salem Harbor 10,159 1450-1000/1000 36.62-CO, 4.41	Astoria 9,815 1800-1000/1000 33.70-O, 3.94

† KEY: Station name
Annual station heat rate, Btu per kwhr net output
Turbine throttle pressure, psi – turbine throttle temperature, F/reheat temperature, F
Fuel cost, cents per million Btu – Fuel; C = coal; G = gas; O = oil
Total production expense, mills per kwhr net output

* – Includes expenses of additional steam unit

** – Gas at 25.73¢/10^6 Btu

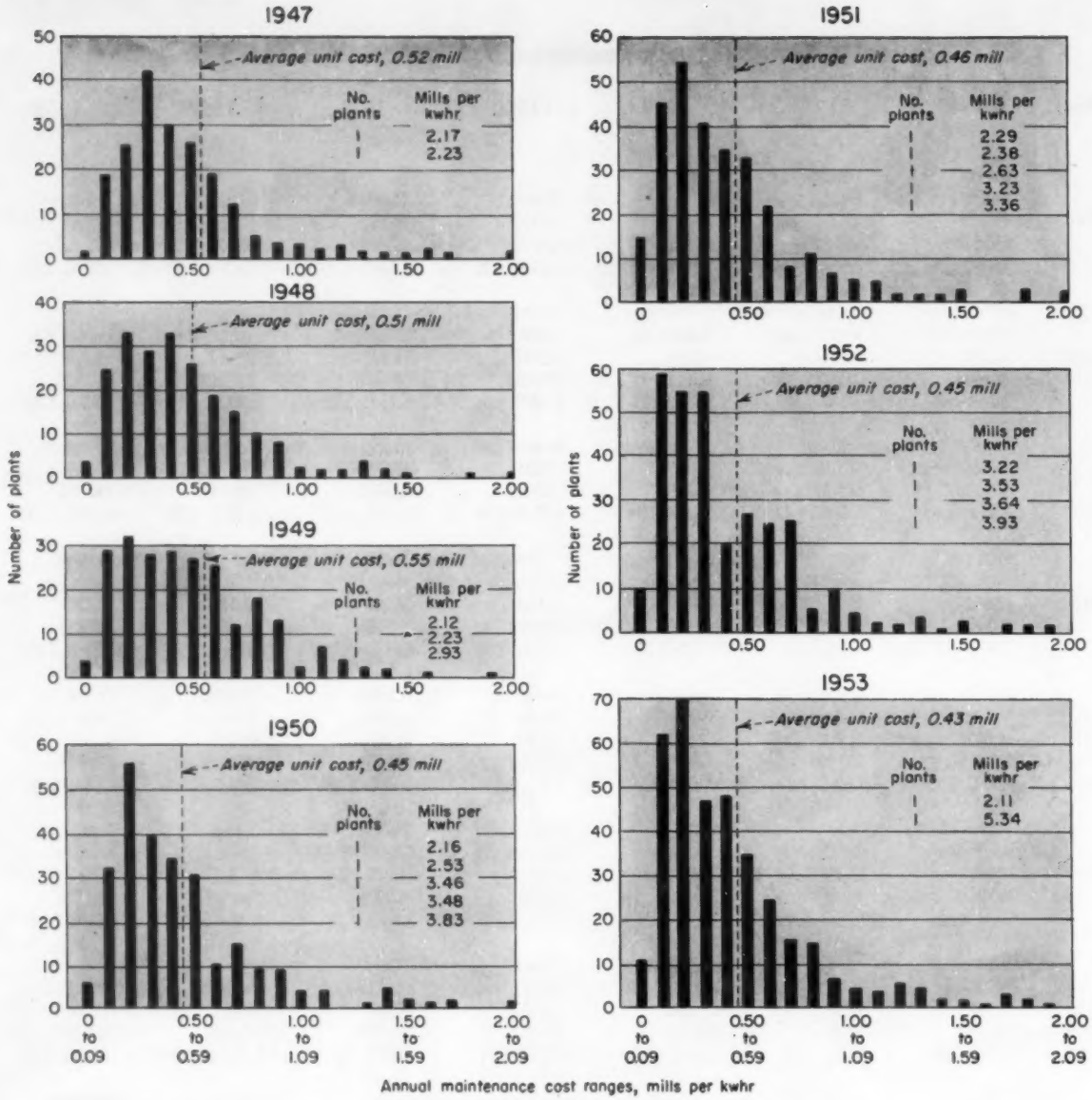
NR – No record

Table II: Ten best production-cost rates, 1947 to 1953

Rank	1947	1948	1949	1950	1951	1952	1953
1st	Harvey Couch † 12,620 650-830 3.57-G, 0.83	Harvey Couch 12,321 650-830 3.95-G, 0.94	Harvey Couch 12,258 650-830 4.58-G, 0.95	Trinidad 14,401 375-750 3.51-G, 0.99	Trinidad 14,560 375-750 3.51-G, 1.00	Trinidad 14,656 375-750 4.11-G, 1.10	Trinidad 14,854 375-750 3.71-G, 1.04
2nd	Nueces Bay 14,244 375-825 3.3-G, 1.04	Nueces Bay 14,417 375-825 3.3-G, 1.05	Nueces Bay 13,677 850-910 3.3-G, 1.09	Harvey Couch 12,309 650-830 4.59-G, 1.04	Lieberman 11,872 800-900 6.25-G, 1.10	Nueces Bay 13,524 850-910 3.97-G, 1.17	Nueces Bay 13,523 850-910 3.93-G, 1.08
3rd	Trinidad 15,893 375-750 3.58-G, 1.09	Trinidad 16,015 375-750 3.67-G, 1.15	Lieberman 11,695 800-900 6.42-G, 1.14	Nueces Bay 13,325 850-910 4.71-G, 1.04	Nueces Bay 13,637 850-910 4.11-G, 1.13	West Junction 12,424 850-905 9.36-G, 1.35	Knox Lee 12,142 850-900 8.17-G, 1.28
4th	West Junction 12,946 850-905 7.5-G, 1.35	West Junction 12,872 850-905 7.5-G, 1.23	Greens Bayou 12,477 850-905 7.5-G, 1.20	Lieberman 11,613 800-900 6.16-G, 1.05	West Junction 12,466 850-905 8.41-G, 1.24	Knox Lee 12,133 850-900 8.21-G, 1.37	Permian Basin 13,810 600-835 5.29-G, 1.35
5th	Neches 14,032 850-915 5.50-G, 1.49	Lieberman 11,326 800-900 7.50-G, 1.28	Trinidad 16,012 375-750 3.53-G, 1.20	Greens Bayou 12,323 850-905 7.5-G, 1.17	Permian Basin 13,440 600-835 5.10-G, 1.28	Permian Basin 14,030 600-835 5.32-G, 1.38	Greens Bayou 11,951 850-905 9.46-G, 1.38
6th	Sterlington 15,504 850-905 5.8-G, 1.52	New Handley 12,150 850-905 7.75-G, 1.46	West Junction 13,046 850-905 7.5-G, 1.29	West Junction 12,673 850-905 7.5-G, 1.23	Greens Bayou 12,278 850-905 8.41-G, 1.32	Greens Bayou 12,323 850-905 9.36-G, 1.40	West Junction 12,411 850-905 9.54-G, 1.43
7th	Arsenal Hill 17,184 250-NR 5.97-G, 1.55	Neches 13,941 850-915 5.50-G, 1.49	Permian Basin 13,450 600-835 5.02-G, 1.37	Permian Basin 13,700 600-835 5.02-G, 1.24	Knox Lee 12,182 850-900 8.09-G, 1.44	Waleetka 14,484 375-675 5.81-G, 1.44	Ninemile Point 11,110 1550-1005/1000 11.64-G, 1.55
8th	Waleetka 15,300 375-675 6.49-G, 1.65	Sterlington 15,552 850-905 6.10-G, 1.54	Neches 13,364 850-915 5.50-G, 1.47	Neches 13,288 850-915 5.51-G, 1.30	Harvey Couch 12,288 650-830 4.61-G, 1.50	Mustang 11,944 850-900 9.24-G, 1.45	Louisiana Station No. 2 12,205 875-915 9.21-G, 1.56
9th	Tidd 11,190 1300-925 11.22-C, 1.71	Arsenal Hill 17,409 250-NR 5.95-G, 1.54	Coughlin 13,633 600-825 5.45-G, 1.49	Denver City 17,763 450-750 4.59-G, 1.59	Old & New Handley 12,480 800-905 7.82-G, 1.52	Cecil Lynch 11,681 865-905 10.40-G, 1.48	Morgan Creek 12,410 850-900 9.10-G, 1.67
10th	Mountain Creek 13,490 650-825 7.92-G, 1.73	Industrial Canal 11,851 1250-955 8.84-G, 1.66	Denver City 17,350 450-750 4.56-G, 1.55	Cecil Lynch 11,879 865-905 9.51-G*, 1.60	Mustang 11,985 850-900 9.00-G, 1.54	Louisiana No. 2 12,325 850-915 9.20-G, 1.52	Waleetka 14,534 375-675 7.07-G, 1.69

† KEY: Station name
Annual station heat rate, Btu per kwhr net output
Turbine throttle pressure, psi – turbine throttle temperature, F/reheat temperature, F
Fuel cost, cents per million Btu – Fuel; C = coal; G = gas; O = oil
Total production expense, mills per kwhr net output

* – 42.54-O
NR – No Record



4 Despite rising labor and materials cost the large proportion of new units installed in later years has helped to force down the average unit maintenance cost. Majority of the steam plants have much lower costs than the national average

placed from carrying part of the growing load. In studying Fig. 1, remember that steam-station capacity grew from 34,313 mw on Dec 31, 1946 to 67,237 mw on Dec 31, 1953, practically doubling.

While heat rate measures the efficient utilization of fuel, the main aim is to get a minimum cost per kwhr. When fuel costs are low it seldom pays to install a highly efficient station. Table II (p 83) gives the steam-electric central stations with the ten lowest production costs, excluding fixed charges. None of these stations appear in Table I. Examining the heat rates in Table II, you'll find they are all higher than those in I. On the other hand, all production costs in I are higher than those in II.

Since fuel costs largely govern production costs we find that the fuel cost per kwhr is least for the stations in Table II. Their fuel costs are compared against the national, average fuel cost in Fig. 2 (p 81). Notice that more stations repeatedly appear in all the years in Table II than they do in I despite the large number of new units installed during these years. While these minimum fuel-cost stations show a slight upward trend in Fig. 2, the national average fuel cost has dropped because more efficient stations have been installed. After a sharp rise from 1947 to 1948, average fuel cost per Btu (not shown) has not changed much.

Fig. 3 shows the average maintenance cost for the most active stations in the years 1947 to 1953. The lower curve of figure shows the number of plants that are included in the averages of Fig. 1 to 3 while center curve gives the percentage of the total steam-sta-

(*Continued on page* 208)

By **SAMUEL HELLER**, *President*
American Rectifier Corp

Rotating equipment, mercury-arc still have biggest chunk of the ac-to-dc market. But the portion is being trimmed, with larger slices going to . . .

Selenium rectifiers for dc packaged power

► WITH THE GROWTH in dc-machine applications in recent years (POWER, October 1953, p 110) power men in industrial plants are taking a closer look at available methods of converting ac to dc, near the dc-load centers. What they're looking for is compact, easy-to-maintain, static equipment that can be installed above or below the dc-load equipment, without using valuable plant production space.

It is a special case when a dc-distribution system is installed today to handle scattered dc loads. More general setup has individual converting means for each dc-load unit.

Keeping industry's needs in mind, it's easy to see how selenium rectifier applications have zoomed in recent years (POWER, August 1952, pp 84-87). In light of the growing importance of dry-type rectifiers, let us look into their characteristics, advantages and limitations.

Manufacture. Selenium cells are rated by volts and amperes. Maker's guarantee specifies an operating voltage within limits that are fairly wide. Occasionally, excessive voltage may cause stack sparking. (In a test setup we applied double-rated voltage with no permanent harm to the stacks). But we don't use this as an operating procedure.

Overloads are taken in stride as indicated on curves, p 87. But sustained overloads can lower rectifier efficiency by reducing valve action. Rectifier aging may be stepped up by overloading. Aging depends on load, temperature and nature of duty cycle.

As a case in point, the Westchester Airport has a selenium rectifier rated for 400 amp. But the manufacturer guarantees 800 amp can be drawn for a full half-minute if (1) a one-minute interval is allowed between such loading and (2) number of such cycles is limited to seven. As indicated in curves, p 87, even ten times full-load rating may be drawn, and guaranteed by the maker, if the duty cycle is known in advance and the proper time interval allowed between loadings. Normal life expectancy for a selenium operating within its rating is 12 to 15 years.

Rectifier ratings hinge on voltage and current. Usually lower-voltage plates carry more current than high-voltage units. Current ratings vary from 1/3 to 1 amp per square inch of surface. Let's suppose input voltage is 208. If a

To shoot trouble, follow this simple procedure

When testing balky units, first compare no-load amperes with values for new unit: It should be 4 to 8% of the full-load rating. High reading indicates trouble in either stacks or transformer.

Stack trouble can be spotted by using a clamp-on ammeter around leads from secondary of transformer. Look for unbalanced readings. If all stacks are fairly new, replace the faulty stack or stacks.

But if rectifier has a heavy-overload history, it's generally wise to replace all stacks. The total cost is but a fraction of that for a complete unit.

Test results from an ordinary ohmmeter with self-contained battery generally give misleading data. Although a rectifier is a one-way valve it is not a perfect one.

Frequently it requires a cycle or two before it starts carrying current in one direction only. That's why an ohmmeter, delivering pure dc, is often unable to detect a faulty stack.

INDIVIDUAL PLATES form rectifier nucleus. Good conductor and poor one (semiconductor) are basic elements. Current flows more readily from poor to good conductor

Forced-air cooling, generally specified for units above 5 kw, permits upping

40-v plate is used, a stack of five plates totals 200 v. In this case a stack of six plates should be used.

Based on a single-phase bridge circuit, a 40-v plate of a specific size has a maximum allowable current of 8 amp. Total number of plates used here is 24, to meet the 208-v 8-amp requirement.

High operating temperature is a common reason for rectifier failure. However, it is possible to increase plate capacity considerably by forced-air cooling. In an ambient of 95 F a rectifier operating at full load will measure 200 F at the plates. With forced-air cooling, plate rating can be stepped up 100 to 150%. Thus an 8-amp plate can handle 16 to 20 amp. And since cost of plates is greater than cost of forced cooling, large units are often provided with auxiliary cooling. Fans also mean less space is required for the rectifier. In all units above 5 kw, a fan-cooled unit is generally preferred. Quantity of air required for forced cooling varies between 300 and 800 linear fpm over each plate.

Voltage regulation enters the picture when fan cooling is adopted. With normal convection cooling (NCC), cabinets are designed for free air passage or, where this is not practical, larger stacks are used and derated.

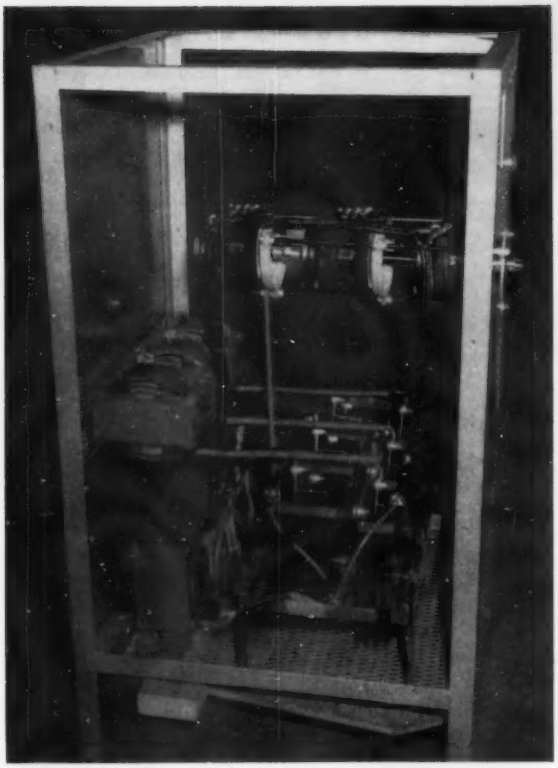
There is a larger voltage drop between no load and full load in a forced-air-cooled unit compared to a NCC rectifier. Depending on specific design, voltage drop in an NCC unit runs between 8 and 10%. You can expect between 10 and 20% in a forced-cooled unit unless there are additional stacks. We use a maximum of 16% regulation in forced-air units.

Recently we built a 300-kw rectifier for a coal-mine application that points up a variation on the regulation problem. Here, voltage had to be maintained roughly constant over the complete load range. We set the output voltage at 293. Magnetic amplifiers maintained dc voltage within 6 volts from no load to 125% load.

Cost of stacks is between 10 and 20% of total cost for larger units. In a 300-kw rectifier, components include a 2-winding transformer, fan, magnetic starter, pushbutton, fan relay (cuts out magnetic starter if fan fails) thermostat (to prevent overloading), selenium stacks, and a steel cabinet. In addition, magnetic amplifiers are supplied, plus automatic reclosing circuit breakers for input and output.

Rectifier circuits are varied: simplest is single-phase half-wave. Single-phase full-wave and single-phase center-tap connections are also used. Polyphase circuits include 3-phase half-wave, 3-phase full-wave, 3-phase bridge, 3-phase center-tap and, finally, the 6-phase arrangement.

Advantages of selenium units can be summed up in terms of low initial cost, high efficiency, simplicity and reduced maintenance. Application-wise, they are making great strides in the lower-voltage fields, such as plating. Today, most manufacturers of large rotating equipment hesitate to build a low-voltage mg set except on special order. In the medium-size range, say 50 to 100 kw, the selenium unit has a keen edge, especially where an induction rather than a synchron-



ASSEMBLED UNIT holds transformer, rectifier stacks grouped in proper circuitry, and means for simple varying of dc output

capacity of selenium plates 100-150%

ous motor is used as driving medium for the dc generator.

Dry-type (selenium) rectifiers have an entirely different efficiency characteristic from rotating equipment: Efficiency is constant regardless of size, provided the connection is the same. Thus a large 3-phase unit, say 300 kw or above, is no more efficient than a 1-kw rectifier.

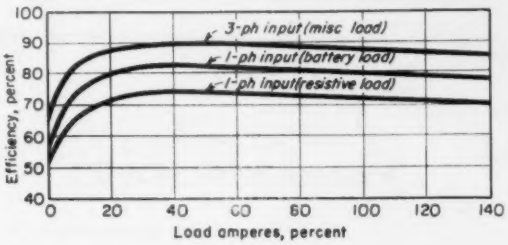
Small dry-type rectifiers lack some of the characteristics of an mg set. If variable voltage is needed, it can be handled as economically today with a rectifier as with an mg set. But where remote or automatic control are specified in addition to variable voltage, the rectifier is generally more expensive than the mg set.

Where to use a specific type rectifier—whether dry type, mercury-arc, mechanical, or an mg set—can only be determined after all the requirements are known. Each conversion means has its place in industry.

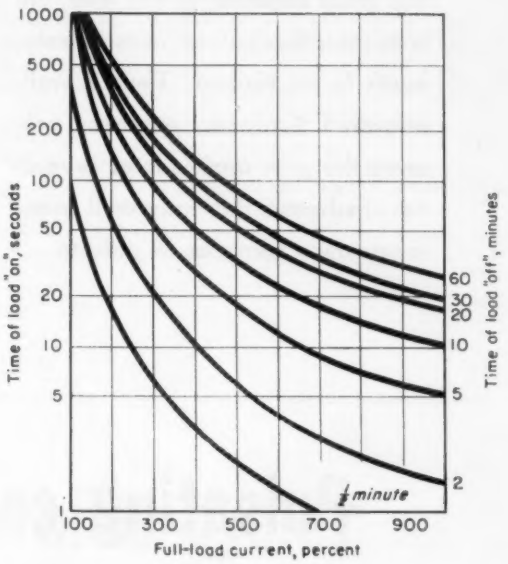
Nevertheless, the selenium units have carved out a unique set of advantages that are worth listing: (1) They are noiseless except for the sound of the fan. (2) They require no special foundation or leveling. (3) Only a pilot light is needed to tell when they are on the line. (4) Efficiency is high at no load and full load.

Because of high no-load efficiency, we often recommend that a customer keep his high-voltage units (2.3 kv and above) on the line over weekends. Small losses at no load are better to live with than the line surges into the transformer when unit is switched.

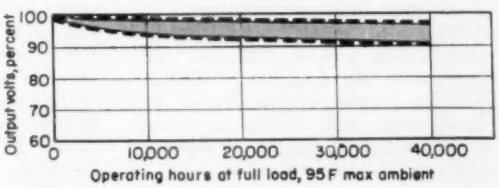
What you can expect from modern packaged selenium rectifiers



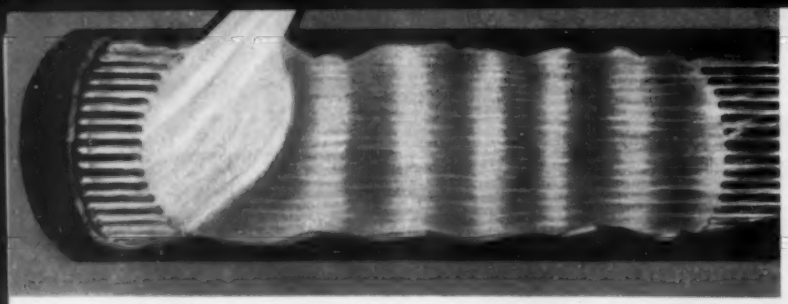
EFFICIENCY HOLDS HIGH well into low-load and overload range. Today's selenium units are suited to start loaded motors or handle intermittent heavy dc loads



ALLOWABLE OVERLOADS depend on load period, type cooling, ambient temperature. Above curves are conservative. Partial loads can be drawn during off-peaks



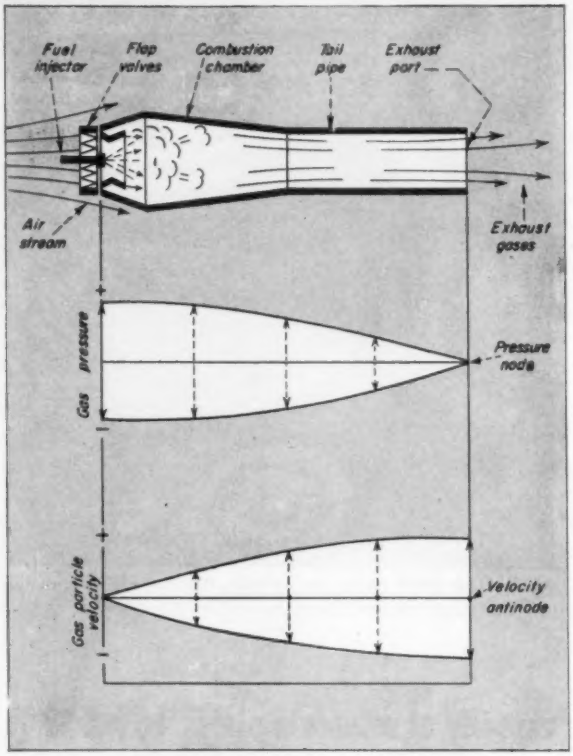
AGING CHARACTERISTICS hinge on many factors. Note that above curve is based on full-load hours of use. Aging of any unit is slowed considerably under light loading



SECOND OF A SERIES

By F H REYNST, *Combustion Engineer*

The great potential of this idea, old in its inception but still in its infancy, waits to be tapped. Here a well-informed European engineer presents the pros and cons of several novel schemes that may well cause tomorrow's furnaces to pulsate



1 Schematic diagram of German V-1 pulse-jet showing maximum and minimum pressure and velocity variations of gases

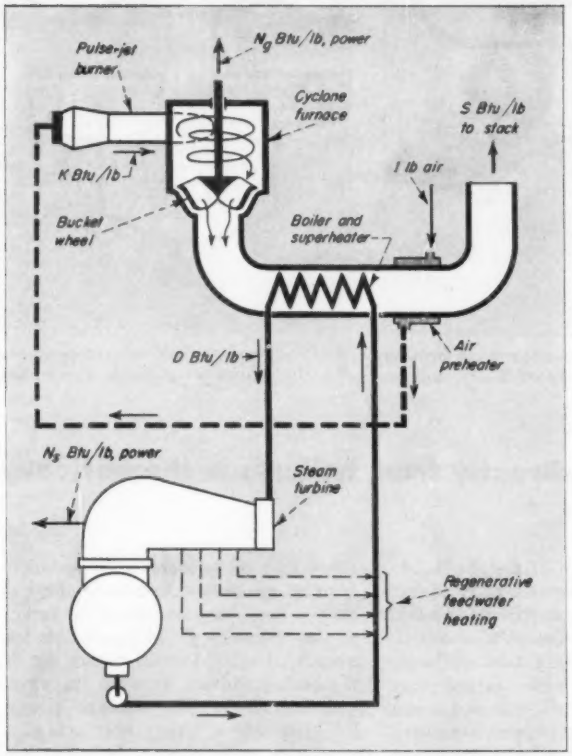
Pulsating combustion: Can we use

► EQUIPPED WITH a review of acoustics and vibration fundamentals (August POWER, pages 88-91), we're now ready to take a closer look at some of the ways pulsating combustion might improve steam-power performance.

Modern boilers and their earlier prototypes have a basic similarity: Both operate on the principle of constant-pressure (continuous) combustion. Pulsating combustion—a constant-volume process using intermittent, controlled explosions—is now being explored by leading European boiler manufacturers as a means of boosting thermal efficiency, heat transfer and heat-release rates in large steam-power plants. To see how this improved performance might be achieved, let's look into some possible arrangements.

The cyclone furnace. We know that a mixture of pulverized coal and air can, under certain conditions, produce violent explosions. This explosive force was at one time put to work in diesels, but erosion of wearing surfaces proved an insurmountable problem. Even gas turbines are unable to withstand the erosive action of fine ash particles although these machines don't have wearing surfaces, such as cylinders and pistons have. The only material that's actually immune to erosion is ash itself —in liquid state. So if we want to explode coal particles in a furnace to produce pulsations, the cyclone furnace whose inner surfaces are covered with molten slag presents a good starting point.

We want to build up powerful whirls in our cyclone furnace with these pulsations, and convert some of this whirl energy directly to mechanical power, as well as supply heat for steam generation. Every horsepower we get out of our boiler by harnessing pulsations lowers the fuel bill—if steam-plant efficiency remains constant. This is reasonable because: If we produce only steam, the heat units transmitted to steam are transformed into power with a thermal



2 Hookup of gas-steam cycle with power-generating boiler. Bucket wheel located in furnace is serious drawback here

← Cycle heat balance

Per lb of combustion air:
D: Btu per lb transferred to steam
N_g: Btu per lb direct mechanical power from boiler
N_s: Btu per lb mechanical power from steam cycle
S: Btu per lb lost through stack
K: Btu per lb released by pulsating combustion
Then

$$K = D + S + N_g \quad (1)$$

And the various efficiencies are:

Steam-cycle thermal efficiency: $n = N_s \div D$ (2)

Boiler efficiency: $e = (K - S) \div K$ (3)

Gas-cycle thermal efficiency: $k = N_g \div K$ (4)

Over-all thermal efficiency: $E = (N_g + N_s) \div K = ne + k(1 - n)$ (5)

Example:
With $n = 45\%$ for a supercritical-pressure cycle and $e = 90\%$, over-all thermal efficiency with constant-pressure combustion is: $0.45 \times 0.90 = 40.5\%$.
If $k = 9.6\%$ (see discussion below) then from equation (5) over-all thermal efficiency climbs to 45.8%

cyclone furnace, air-turbine cycle?

efficiency that is approximately 40%.

But if we also produce mechanical power directly, then a certain amount of heat energy is transformed into power at 100% efficiency, neglecting mechanical losses. Fewer heat units remain to be transmitted to the steam cycle. We'll come back to this reasoning later when we establish the heat balance of our power-generating boiler. First, let's see how we might build such a unit.

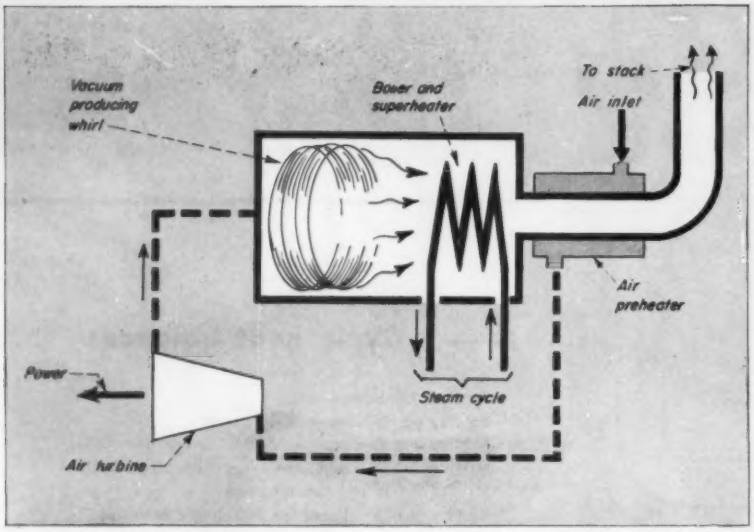
Pulse-jet burners. During World War II Germany developed the V-1 buzz bomb. The pulse-jet engine that propelled the bomb worked on the constant-volume cycle. It even burned pulverized coal at the end of the war when Germany's gasoline supply ran out. The pulse-jet, Fig. 1, is simply a pipe open at one end and closed by flap valves at the other end.

The combustion gas oscillates in it the same as air in an organ pipe oscillates on quarter wave lengths. During negative pressure at the closed end (point of pressure antinode) a mixture of fuel and air is sucked in through the flap valves. Ignition follows a half period later during positive pressure. The gas explodes and expands toward the open end. Good pulse-jets transform as much as 20% of the fuel's heat into kinetic energy of the outflowing gas.

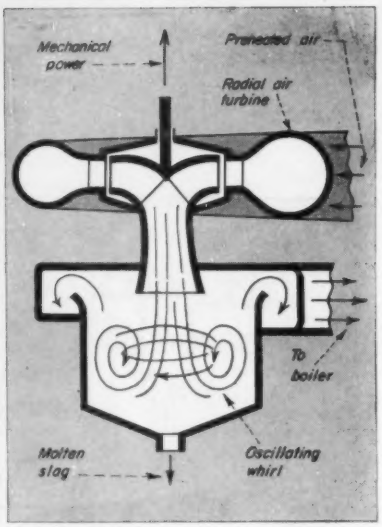
If we heat our boiler with pulse-jets, we might expect their thermal efficiencies to be only 12% because of the high inlet-air temperature, see cycle diagram, Fig. 2. Pulse-jets, cooled by boiler feed, produce jet of hot high-velocity gas which has whirling motion on entering cyclone furnace tangentially.

If we don't use kinetic energy of this whirling gas, turbulence soon sets in and the kinetic energy becomes heat. This heat is absorbed by the steam and no improvement in thermal efficiency is realized. But if we place a bucket wheel within that cyclone with, say, a hydraulic efficiency of 80%, we can theoretically extract:

$0.80 \times 0.12 = 9.6\%$ of the fuel's



3 Improved arrangement of gas-steam cycle extracts mechanical power from furnace by means of vacuum-producing whirl. Flue gas does not contact the air turbine



4 Drawing shows how vacuum-producing whirl pulls air through the turbine

Extracting mechanical power directly from boiler can theoretically

heat in the form of shaft horsepower. The remaining 90.4% is used for steam generation. With the cycle arrangement shown in Fig. 2, direct power extraction from the boiler should not lower steam-cycle efficiency. But since less heat is available for generating steam, we'll need to burn more fuel. Cycle calculations, Fig. 2, show that we can boost thermal efficiency better than 5%.

Air-turbine cycle. With the arrangement of Fig. 2 our bucket wheel in the cyclone furnace will soon be eroded. Instead of the bucket wheel in a stream of furnace gas let's consider the setup of Fig. 3 and 4—using an air turbine. Within the whirling furnace gas, pressure is below atmosphere. It can, therefore, provide sufficient vacuum to pump preheated combustion air through the turbine. We don't have to bring the air to a very high temperature because the turbine acts only as a pressure-energy converter, not as a heat engine. Heat-engine action occurs in the whirling combustion gas, with standing waves oscillating between its center and periphery.

The idea of whirling gas with radial standing waves is a difficult one to grasp and still more difficult to attain. Let's try to picture it by a mechanical analogy, Fig. 5. Consider a rotating garden sprinkler. Multiply the number of arms many times and assume each arm is a pulse-jet engine. The jet's center line makes a 90-deg angle with the axis of rotation at a point near the flap valves. The gas in the tube is thrown toward open end by centrifugal action, thus creating partial vacuum near center. If we let these imaginary tube walls disappear, we're left with whirling combustion gas and pulsating standing waves between center and periphery.

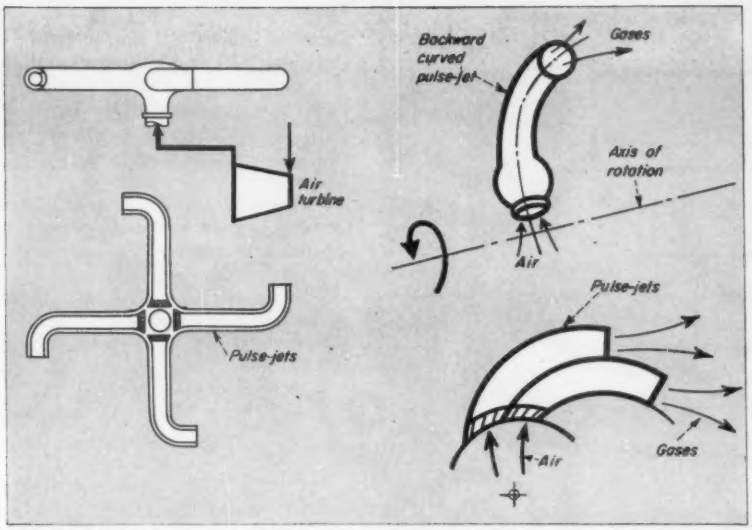
Vacuum energy. The vacuum, created by the whirl, pumps preheated air through the air turbine and blows combustion products at high speed through the flue-gas channels. Our air turbine has practically unlimited life if we can provide it with clean air. The inner walls of the cyclone furnace are protected from erosion by the thin layer of molten slag that is centrifuged from the whirling gas. Result: We can boost total plant efficiency 5% and run our power plant on the poorest coals—those with a high ash content.

Remember, we've only used rotating pulse-jets as a mechanical analogy. Success of this power-generating boiler depends on finding some practical way of setting up these whirls. Boiler engineers are only too familiar with rumbling, drumming or roaring in furnaces. In severe cases it is capable of shattering nearby windows. Exactly what causes this action is not entirely known, but we've learned to suppress it by rounding off sharp corners in the path of flue gas where intermittent whirls may develop, see Fig. 6.

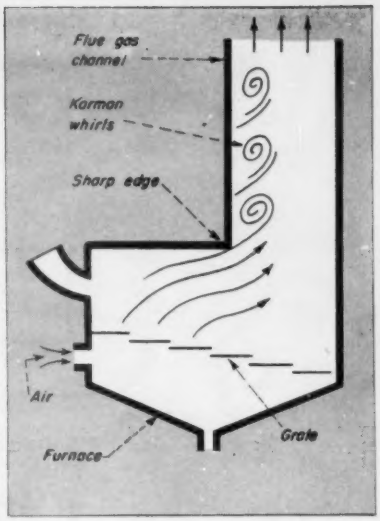
Instead of taking the negative viewpoint, let's try to increase these whirls. Suppose we *tune* a flue-gas channel in such a way that the natural frequency of the channel coincides with the frequency of whirl formation—setting up resonance condition between the waves and the whirls. The resulting powerful intermittent whirls thus act as a regulating valve, alternately extinguishing and accelerating combustion. If we place a nonreturn flap valve across the opening to prevent gas flowing in the wrong direction during part of the cycle, we have actually come back to the V-1 pulse-jet. Thus far the deafening noise of pulse-jets puts them at a disadvantage for boiler applications.

But there is a more serious problem. Thus far, we've talked about "explosions" or constant-volume combustion processes, to explain pulse-jet functioning. Explosion means conversion of chemical potential energy into sensible heat with such rapidity that pressure is increased in the open vessel from zero to about 44 psi (three atmospheres). Then expansion occurs, converting sensible heat into kinetic energy of the gases. So we aren't getting that kinetic energy directly from chemical energy. There is needless sensible heat as an intermediate step. It is almost like converting electricity into power by an electroboiler.

What we are after is this: Creation of whirl energy direct from chemical energy, eliminating sensible heat and



5 Mechanical analogy pictures whirl as a group of backward curved pulse-jets rotating about a common axis. Remove pulse-jet walls to imagine the actual whirl



6 Formation of Karman whirls at sharp edge. We want to amplify this effect

boost thermal efficiency 5% or more

the expansion process. In fact, the so-called "explosion" of the pulse-jet engine is not an ordinary rapid combustion process, such as occurs in our car's engine. In the pulse-jet, particularly in whirls of rumbling boilers, chemical energy is liberated as whirl energy. Then whirl energy breaks down, becomes turbulence energy. Finally, we get sensible heat with such speed that pressure increases to 44 psi. The pulse-jet's basic defect is this breakdown of whirl energy and turbulence decay (turbulence becoming heat).

For direct conversion from chemical to whirl energy, furnace shape should curl inflowing laminar mixture up in a whirl.

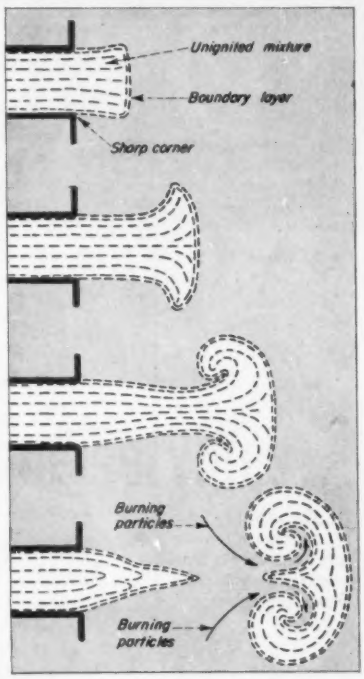
Flow within whirl is also laminar, see Fig. 7, because the gas particles move in curved paths. During formation of the whirl in the furnace, burning particles are prevented from contacting the mixture. But as soon as the whirl of unignited particles breaks away from the intake nozzle, burning particles enter the whirl at high speed. Explosion follows. Is this a direct transformation of chemical to kinetic energy? If so, there must be a vacuum at the core of the whirl—a vacuum capable of doing useful work. Let's conduct a simple experiment to show that periodic whirls can be formed by such repeated explosions.

Jam-pot experiment. All we need is an old jam pot with screwed-on airtight lid, see Fig. 8. In the lid, pierce a hole, its diameter about one-fifth of pot's ID. Now pour some methyl alcohol into pot and hold a lighted match near the opening. Blow on it. If the vapor-air mixture has the right strength—depending on temperature—a flame jet shoots out of the opening. This is an ordinary explosion. But then this crude device starts rumbling. There is no visible fire outside the opening. Gas is ejected, and in rapid succession air is sucked in. These are actually vacuum-producing explosions.

Why is air pulled into the pot? There is no natural oscillation of a gas column that causes this. The answer might easily be discovered by a laboratory equipped with high-speed cameras, oscillographs and stroboscopes.

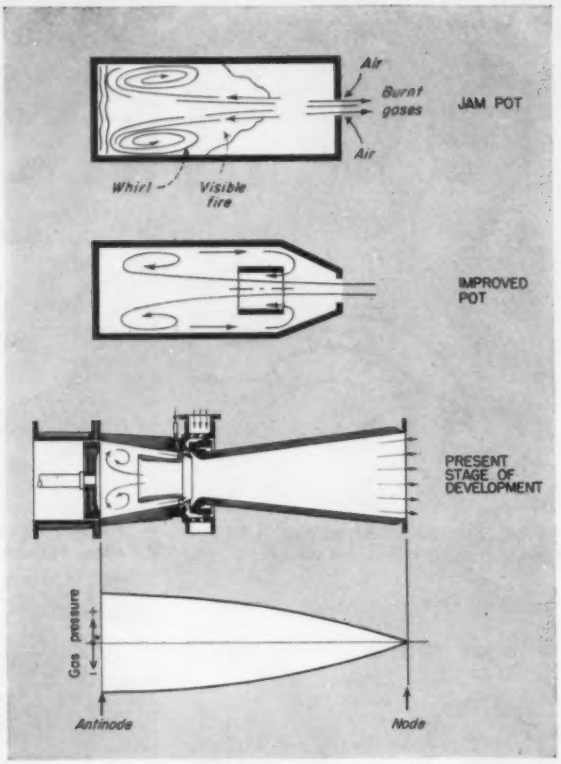
I have tried pots of various shapes. With improved carburation, the rumbling can be controlled at will. With exhaust pipe of correct length and diameter, the device oscillates on a quarter wave—like the pulse-jet. We get a pressure antinode at the bottom of the pot and a pressure-node at open end of the pipe. But where we had that straight pulsating column in the pulse-jet, we find a ring whirl in the pot. Newer pots have a venturi tube between opening and bottom to get more powerful whirls.

At the present stage of development the length of the pot-with-pipe system is about three feet—giving a pulsation

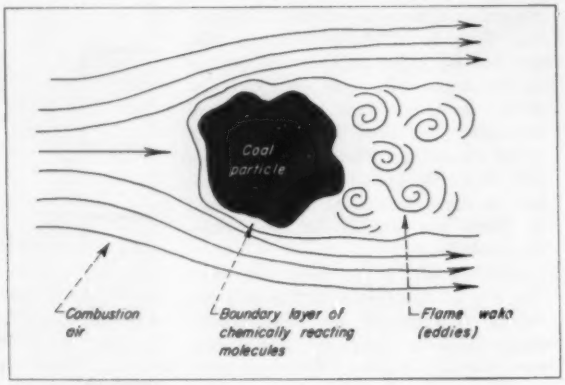


7 Life cycle of whirl. Burning gas explodes the mixture after breakaway

frequency of 200 per second. The system can pull in combustion air through a throttle valve against a pressure drop of 1.5 psi. This is still too low to make the air-turbine idea practical. But if we shorten the exhaust pipe inch by inch and widen the opening successively by sixteenths, frequency climbs and the suction power is amplified. We finally reach a point where the pressure node



8 Early jam-pot experiments led to development of pots with venturi tube to reinforce whirls



9 Combustion process in a pressure wave. Particle is completely burned in one pulsation

Furnaces need high area/volume ratios

coincides with the pot's opening. The gas column in the pot oscillates on a quarter wave and we have a ring whirl of very short wave length. If this whirl supplies sufficient vacuum energy, the air turbine can be put to good use.

Heat-release advantages. So far we've discussed the entire plant cycle from the thermal efficiency viewpoint. Now let's look into the heat-transfer and heat-release characteristics of a pulsating furnace. Experiments with the pulse-jet show it can burn pulverized coal at extremely high specific-heat release. This simply means that coal particles react with surrounding gas at high speed. Table, following, shows that pulse burners release heat many hundred times faster than ordinary burners.

Furnace	*Specific-heat release*
Pulse-jet	5,000,000 Btu/cu ft/hr
Ordinary	10 to 50,000 Btu/cu ft/hr

Furnace	*Specific-heat transfer*
Pulse-jet	100,000 Btu/sq ft/hr
Ordinary	50 to 90,000 Btu/sq ft/hr

Formula 5 (POWER, August 1954, p 89) can be used to get the velocity of gas particles in a pressure wave:

$$w = (V/k) \times (\Delta p/p) \qquad (5)$$

Suppose we figure gas-particle velocity for pressure amplitude

$p = \pm 0.4\ p$

and for sonic velocity of combustion gas

$c = 3000$ ft/second

Then $w = (3000 \div 1.4) \times (\pm 0.4)$

$= \pm 860$ ft/second

This is a pretty high gas velocity, but it's not the only reason for rapid combustion. The gas is not only moving fast, but it also changes direction a hundred or more times per second—depending on the frequency of pulsation. This results in enormous accelerations, roughly of the order of 32×10^4 ft/sec^2 at 100 pulsations per second. Since the suspended coal particles can't keep up with the rapid back-and-forth movement of the gas particles, they burn rapidly, Fig. 9. Scrubbing action of this high-speed gas also facilitates burning.

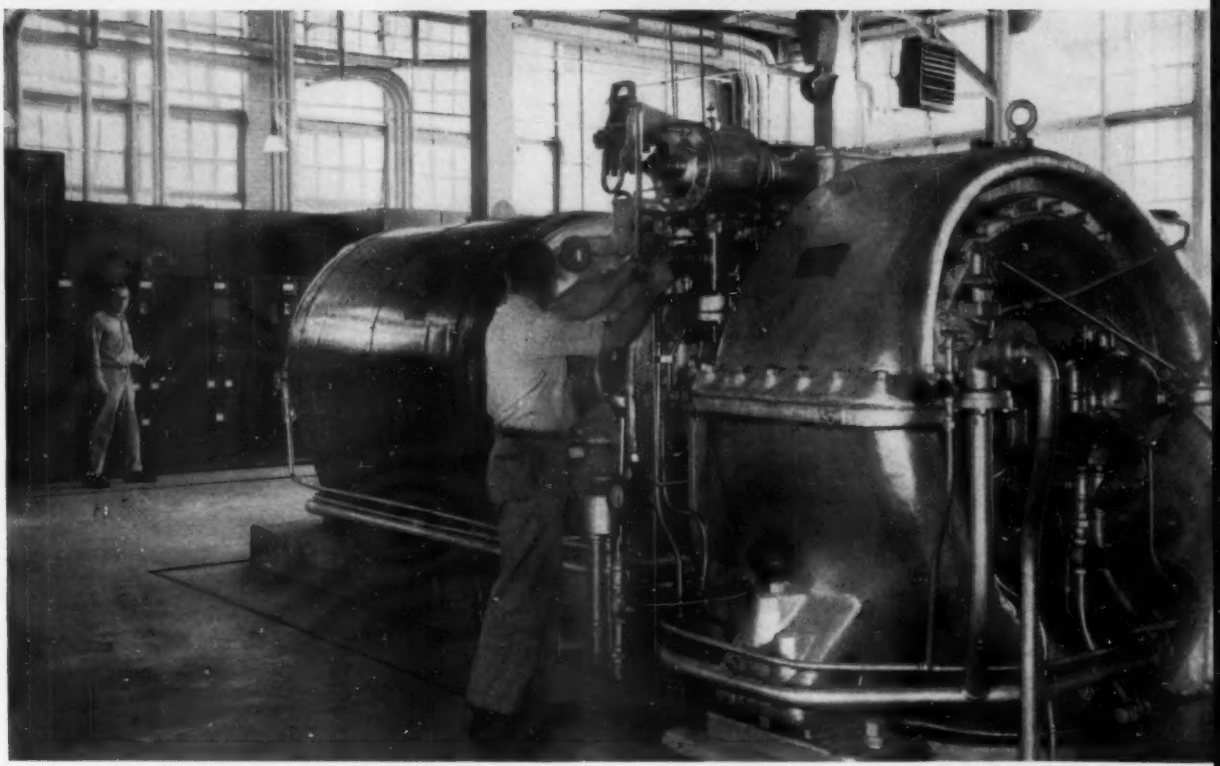
What is the distance between extreme positions of a gas particle? In round figures: three feet at 100 pulsations per second. This distance is considerable compared with the dimensions of a coal particle. Particles are completely burned in one pulsation—1/200 second at 100 pulsations per second.

Boiler design. The big problem here is ash disposal. So far, experiments with organ-pipe pulse-jets show that the coal is completely burned at the outlet of the tube and that the ashes are liquid. They can be separated by the cyclone furnace, but not completely. The gas leaving the cyclone is very hot and carries small droplets of ashes. These could solidify on the heating surface and cause trouble. A large radiant cooling space between cyclone and heating surface would solve this problem. But we would then lose all the advantages of high heat release. If we still need large cooling spaces, it would actually be more practical to burn the coal directly within the space, at constant pressure.

Since we can't eliminate slags completely we must cut back combustion temperature so ashes are formed in the solid state. This means intensive cooling of the gas *during* combustion.

Let's take another look at the table

(*Continued on page* 214)



REWINDING 2500-KVA GENERATOR for 4.1 kv was but one step in the power-service expansion of this Danville, Pa. plant

Merck & Co took over a government-surplus plant...

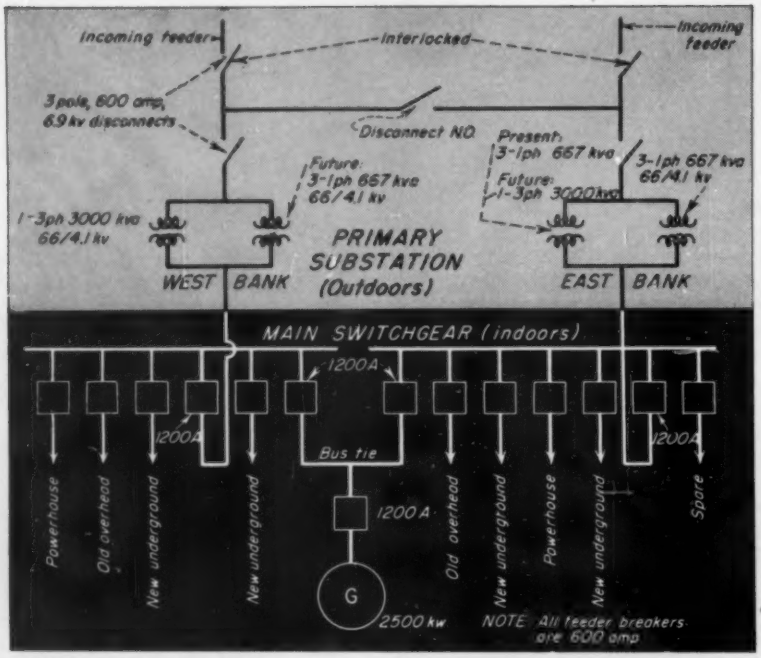
Modernized electrical and steam services...

and wound up with a top-flight layout geared for tomorrow's loads

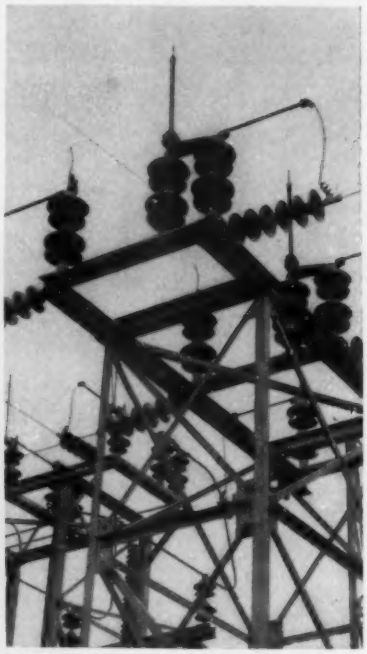
By **ROBERT B PACE**, *Utility Engineer, Merck & Co Inc*

ELECTRICAL **Primary-distribution voltage boosted from 2.3 to 4.1 kv. At this higher voltage, main switchgear can carry 12,000-kva peaks compared to 5000 kva at 2.3 kv. Existing transformers are used at higher voltage by reconnecting. Service continuity stressed**

STEAM **In general, the power-plant mechanical equipment was in sound operating condition. But Merck's plans to modernize and expand their complex and highly critical manufacturing operations called for general overhaul of the boilerhouse gear** *Turn page*



PRIMARY DISTRIBUTION setup includes original outdoor transformer substation, main switchgear indoors adjacent to plant generator. Bus tie increases flexibility



EITHER BANK of transformers may be fed from single feeder through this bus tie

ELECTRICAL:

All new primary-distribution feeders are underground

Before modernization, setup consisted of a 4000-kva primary substation, main switchgear in powerhouse annex, a 2500-kw generator driven by a condensing turbine, and an overhead 2.3-kv distribution system. Primary substation transformers stepped down the incoming 66 kv from utility company to 2.3 kv for plant distribution. In addition, each of the four main manufacturing buildings had a 425-kva substation. Here the 2.3 kv distribution voltage was stepped down to 480 and 120 for power and lighting needs.

Shortly after Merck took over the plant, our engineers tackled the project of enlarging and extending its electrical system. We planned to make maximum use of existing facilities in line with modern engineering practice. That called for tailoring the installation to meet present and anticipated needs.

We had several critical load areas to consider. Any power interruption in these areas could well prove far more expensive than the cost of prevention. Looking to the future, we calculated that within the first two years of operation plant load would reach peaks of 6000 kva. Beyond that, future peaks might vary from 9000 to 10,000 kva.

Why 4.1-kv distribution? Distribution voltage before revamping was 2.3 kv. Our studies showed it more economical to convert to 4.1 kv for all primary distribution. Here are the factors that influenced our going to this higher voltage:

1. Main plant switchgear was originally designed for 15-kv service. But it was converted to 2.3 kv when installed. At this lower voltage the maximum capacity of switchgear was 5000 kva. We figured that loads would be well in excess of 5000 kva. So by converting this switchgear to 4.1 kv, and splitting the bus, it would be possible to carry peaks of 12,000 kva without adding new switchgear.

2. Smaller cables could be used at the higher voltage, reducing cost of proposed feeders to new manufacturing areas. To handle loads in those new areas, nine 1500-ft runs of 350 Mcm underground cable would be needed if primary voltage remained at 2.3 kv. By changing to 4.1 kv the number of runs could be cut to four.

3. Existing plant overhead distribution feeders would carry greater loads at the higher voltage.

4. It would not be practical to adopt a voltage higher than 4.1 kv since we would not be able to utilize the existing primary transformers and the four secondary substations.

Some changes were necessary in the primary substation, switchgear, overhead distribution system and secondary substations before swinging to 4.1 kv. In the primary substation transformer, connections were changed from delta-delta to delta-wye. In the secondary-load-center substations, transformers were reconnected from delta-delta to wye-delta. Some rewinding was necessary, too. The 2500-kw generator and high-voltage motors, which were to be

SPARE BREAKER can also be used as tie, connecting load-center to second feed

MODERN CONTROL gear has high-voltage fuses, is used with synchronous motors

MOTOR STARTERS in typical 460-v setup are fed from a common horizontal duct

with a double feed to each secondary sub in key areas

reused, were rewound. Unfortunately neither the high-voltage motors nor the plant generator were originally connected so voltage changes could be made; each unit had to be rewound. There were some changes made in the control wiring, metering, etc, in the main plant switchgear before connecting to the 4.1 supply.

Primary substation's transformer capacity was increased from 4000 to 7000 kva, with plans for easy expansion to 10,000 kva. Local utility company brought in a second 66-kv feeder from another point on their distribution network. Either feeder can carry the plant load. An interlock scheme prevents cross feed between feeders.

Note from the one-line schematic that a failure of one 66-kv feeder, one primary transformer, one circuit breaker, or one distribution feeder will not shut down any plant area for more than a few minutes. Also, a planned outage of a primary transformer, feeder, circuit breaker, or half of the main plant switchgear can be arranged without interrupting service to any load area.

Should future load growth warrant, three of the existing 667-kva transformers will be shifted from east to west bank, and a new 3000-kva transformer installed in the east bank. Thus, eventually, we will have two balanced 5000-kva transformer banks.

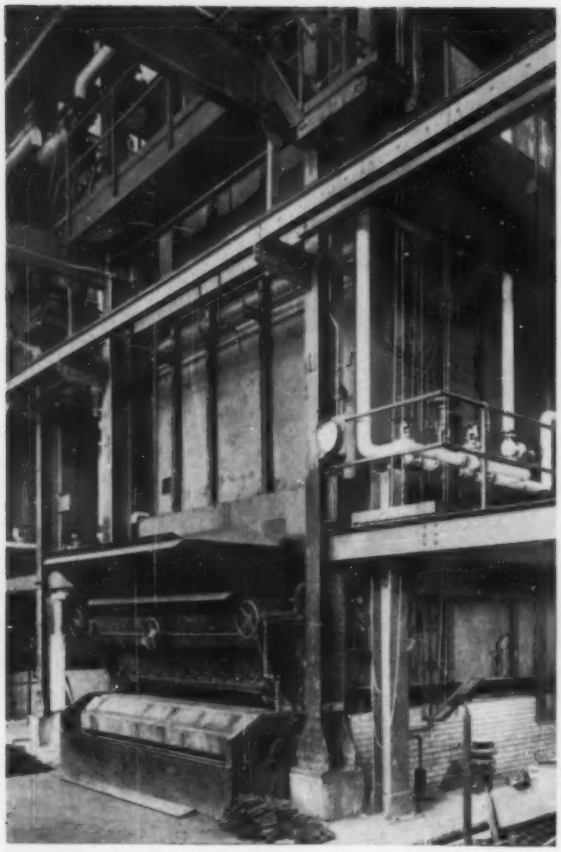
Circuit protection. All primary breakers have an interrupting capacity of 150,000 kva. All feeder breakers have over-current relays. Both feeders between primary substation and main switchgear are equipped with over-current and reverse power relays. Tripping contacts on these relays connect to their respective 1200-amp circuit breakers. Any current reversal, if switchgear bus tie is closed while both feeders are energized, will trip the appropriate breaker.

We connected the 2500-kw generator to the bus tie between both sections of the main switchgear. Generator has reverse power, and differential relays.

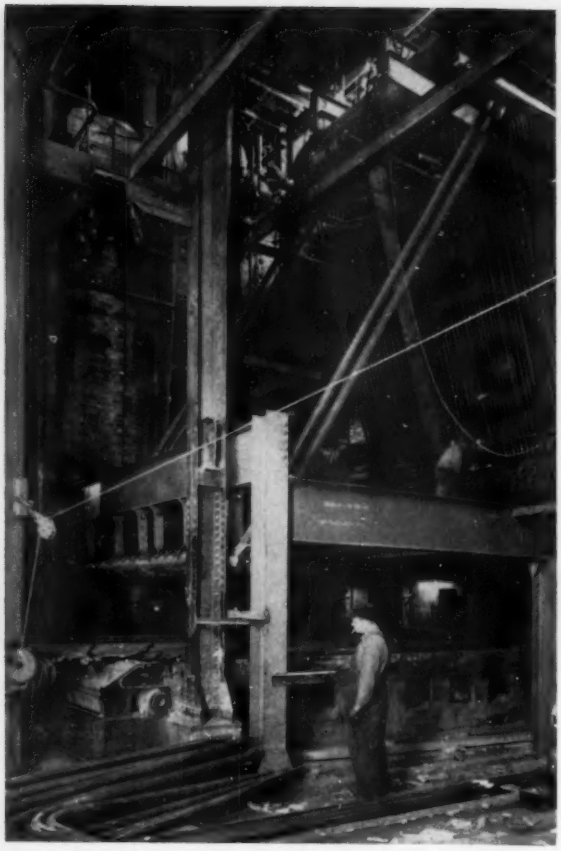
Primary feeders. Underground distribution, using concrete-encased conduit, was adopted for high-voltage feeders to all new manufacturing areas. A modified selective network system is used. This scheme boils down to: (1) Two feeders to each secondary substation in a major manufacturing area (2) a double-ended transformer substation in the two most important manufacturing areas (3) spare underground conduits, which permit increasing the number of cables as plant expands. Substations in less critical areas are set up on a selective radial system allowing operation from either one of two feeders.

We have one spare 1200-amp breaker in the plant ready for use in any secondary substation. This breaker can be installed in a spare cubicle on the high-voltage side of secondary substation. After putting in place, the breaker is closed and the other high-voltage breaker tripped, removed without interrupting electrical feed.

Turn page for Steam Services



TWO NEW BOILERS, rated 60,000 lb per hr each, were erected over grates of two of the three old 30,000-lb-per-hr units



INSTALLING BOILERS on existing traveling grates saved expensive extension to building and foundation in the powerhouse

STEAM:

Reliable services and clean operation were musts for the power plant. This called for boiler-house revisions

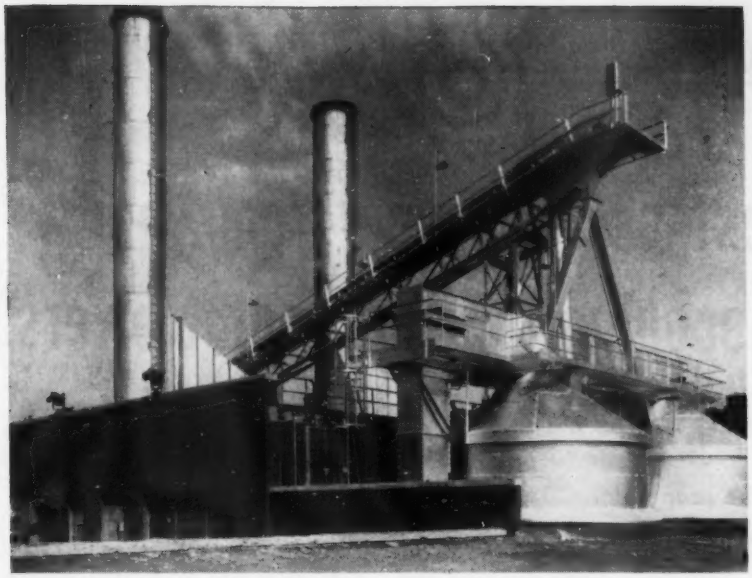
We chose Danville as our new plant site for several reasons. Among them were a large and reasonably modern power plant and underground water mains. Equipment was in good operating condition, but, as plans for enlarging and modernizing progressed, we saw that revisions would be needed. Our final aim was to produce and distribute services at lowest possible cost and, at the same time, have a plant flexible enough to handle wide load variations. Possible future expansion was another consideration.

Original arrangement. Plant had two 100,000-lb-per-hr 450-psig boilers and five 30,000-lb-per-hr 140-psig boilers. Moderate repair made larger units ready for service. Smaller ones were much older, however, and required almost complete rebuilding to put them in reliable operating conditions. All boilers fired coal on traveling grates.

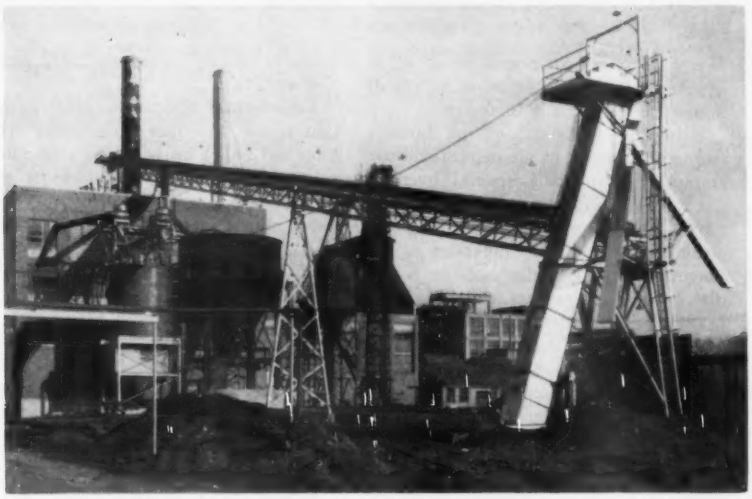
The coal-handling system was originally installed for the five older boilers, and the equipment was old and unreliable. Large boilers were fed by conveyor belt from a coal bunker 200 feet away. This gave very little reserve coal storage at larger units.

The two larger boilers were not equipped with a dust-collecting system. After operating these boilers a short time, we found we were getting an excessive amount of flyash throughout the chemical plant. As the manufacturing and packaging areas have to maintain clean conditions, we had to remedy this situation.

Planning new setup. We laid plans on the basis that the five old boilers would eventually be taken out of serv-



NEW COAL-HANDLING equipment can handle 60 tons of coal per hr; 70-ton-capacity track hopper receives by rail or truck. Feeder and elevator send coal to conveyor



CONVEYOR FEEDS coal to new bunkers. Elevator, at left of bunkers and short conveyor, connects to old coal-handling system; gives boiler supply two complete systems

ice. This meant we would have to install additional boiler capacity to meet anticipated steam load of 250,000 lb per hr. First, we considered an added 100,000-lb-per-hr boiler to go next to two existing units. But this would have called for sizable building and foundation extension, as well as major piping and electrical additions.

We then decided to use as much of existing facilities as possible. Engineering proceeded on the basis of replacing three of the old boilers with two 60,000-lb-per-hr units. Old boilers had previously been reinstalled on new traveling grates designed for steam loads in excess of 60,000 lb per hr. Grates could, therefore, be used for new boilers.

In designing a new coal-handling system, we planned to take full advantage of both rail and truck deliveries, get adequate storage, insure a steady and continuous supply of coal at boilers, and have the system as troublefree as possible.

Our final design called for a track hopper about 200 feet from the plant. Coal path would be from hopper to inclined conveyor belt by way of reciprocating feeder and bucket elevator, and from conveyor to one of two 300-ton bunkers to be installed in front of and above larger boilers. Also, old coal-handling system was to be modified so it could feed coal to new bunkers.

The flyash removal system would consist of primary and secondary collectors and primary and secondary fans. Flyash would be stored in silo for wetting and removal by truck. Primary collector was to be installed between boiler and air heater on the two large units.

Construction. Power-plant operation had to be continuous during revamping. So we planned the construction work with this in mind.

The flyash-collecting system was the first job tackled. Quick deliveries helped here. Silo, secondary collector and fan, primary fan, and 24-in. transfer piping were first to go in. Then the large boilers came off the line one at a time for installation of primary collectors after last boiler pass. To meet steam demands, powerhouse operators relied heavily on the old boilers during the 4-week period when one, then the other, of the larger units was off the line. After boilers were completely enclosed, primary collectors were hooked up to rest of system and equipment went into operation.

In the new coal-handling system, the track hopper and railroad spur over this hopper went in first. Then we installed the two indoor coal bunkers, taking care to safeguard personnel and equipment of boilers operating below. Next came the outside bucket elevator and inclined belt conveyor. Construction went on without a hitch and, after completing and straightening out a few minor operating problems, the new system was turned over to personnel.

With system in operation, work started on modifications to old coal-handling equipment. The final setup permitted feeding coal from old to new bunkers.

We then proceeded with the demolition of the three older boilers that two new units were to replace. One traveling grate was dismantled and stored for spare parts. And, during this time, boiler parts and allied equipment were received and stored for easy access.

With area cleared and foundation installed, boiler erection began. Construction proceeded on schedule, with all phases of installation completed at about the same time. Units were started up with minimum delay, tested and turned over to the power-plant crew.

During the entire 18-month construction period, the powerhouse supplied services for manufacturing-plant operations without interruption.

Get the best performance from your superheater, economizer and soot blowers

Your new boiler will give best service if each element receives the proper care. These practical precautions show you how to avoid a lot of grief before it starts

BY D C SWIFT, *Ebasco Services Incorporated*

► SOME OF THE STEPS you must take for proper operation of superheater, economizer and soot blowers are measuring temperatures at critical points, preventing tube overheating, and insuring against binding under high-temperature conditions. Here's how to avoid pitfalls in operation of these important elements.

Test thermocouples. The safe rate of firing up boilers is usually limited by superheater metal temperatures. This makes it advisable to install thermocouples to measure skin temperature of the superheater elements.

Install the thermocouples, usually chromel-alumel, on typical tubes spaced at intervals across the boiler. Place at points likely to be the hottest—where there is (1) heavy mass flow of high-temperature gas (2) high-temperature furnace radiation, or (3) a superheater outlet nearby.

Chromel-alumel couples are usually made up of asbestos-insulated lead wires of the same material. Methods of installing include peening into shallow holes or shallow parallel slots cut at right angles to the element. Ordinarily, wrap wires around the tube several times, then lead as directly as possible into a cooler, protected zone of the furnace. Sometimes you can insulate wires with a small amount of high-temperature refractory material.

In spite of protective measures the life of thermocouples is rather short. Wires become brittle and break off if touched. A channel or other means of support helps prolong their life.

Bring the leads out of the furnace through a corner of an inspection-door frame, or through a special opening cut in the casing and brickwork. Ordinarily, hook up to a multiple-point switch for convenient connection to the potentiometer. If potentiometer is the direct-reading type, be sure it is calibrated for use with the thermocouple material. If not the compensating type, make a cold-junction correction.

Additional couples attached to the same elements at the superheater outlet, but out of the gas flow, show whether gas and steam flows are balanced across the width of the boiler. Another thermocouple peened into the boiler-drum metal gives an indication of metal temperatures there, so rate of temperature change can be held to safe limits. Install these couples permanently so they will continue to be useful, and last longer than the skin-temperature couples exposed to furnace radiation.

Test and operating instruments are installed before the boiler goes into operation for the first time. These include permanent gage glasses, temperature and pressure recorders, water-level recorders and flue-gas sampling manifolds. The manifold should be designed to give even sampling of flue gas, and piping should be pressure-tested for leaks to insure representative samples and results.

Superheater operation. Most important factor in proper superheater operation is to keep an adequate steam flow passing through all the elements and to avoid high mass flow of hot gas past some individual section. Most of the starting and operating procedures normally used point toward this goal.

Before erection, see that superheater elements are thoroughly blown out to assure freedom from dirt or other obstruction. During the hydrostatic test (after installation) use water as clean as possible, to reduce deposits of mud or dissolved solids in the lowest parts of the superheater tubes.

If boiler is out of service during freezing weather you must protect nondrainable superheater elements. One way, if you can reach the tubes, is to blow out each one with compressed air. Another way is to fill the boiler with compressed air, then blow out the superheater through some large opening like the top of the turbine throttle valve. You need a heavy flow to expel water from all elements. Still another way is to keep a small amount of heat in the furnace.

When boiler with nondrainable superheater has been allowed to cool, the elements usually are full or partly full of condensed steam. As it is fired, water boils out partially in some elements, completely in others. The remaining

water blocks off some elements so no steam can flow, yet the front loops of those elements may be empty and overheated.

Thermocouples installed on superheaters of large high-pressure boilers (see above) should measure the skin temperatures of outside metal. This determines the permissible rate and method of firing to give reasonably rapid firing up while avoiding overheating the superheater.

One method uses burners that supply most of the heat to the superheater while the furnace is still relatively cool and not much steam is being generated. This dries out the elements. Another system uses lower burners adjacent to waterwalls so superheater stays cool because furnace gas is relatively cool until enough steam is flowing to force water out of all elements. As soon as boiler pressure reaches a few psi, close drum vents and saturated-steam vents so all vented steam passes through the superheater, keeping it cool and clearing water out of superheater tubes as soon as possible.

Superheater elements should be evenly spaced, without unduly large openings at the sides, or baffles close by that might cause heavy mass flow of high-temperature gas past the elements. As boiler is fired, pass adequate steam through superheater to keep it cool. If elements overheat, they tend to warp, causing poor gas distribution and further overheating during operation.

Besides thermocouples to measure element-skin temperatures, thermocouples on representative tubes at superheater outlet assist in determining whether burners are giving an even distribution of hot gas, and whether steam flow through the superheater is uniform.

Occasionally, the design or arrangement of the inlet or outlet header is such that little or no steam passes through some of the elements. Sometimes the piping to the inlet header can be rearranged and sometimes the steam flow can be evened up by installing orifices at the tube inlets to increase the pressure drop.

Measure superheater's outlet steam temperature at a point before the drain connection on the outlet header. Otherwise, you will get a false temperature indication during warm-up periods as there will be no steam flow past the temperature element.

The superheater must be protected if you suddenly lose load on the boiler while heat, direct from fires or radiated from setting, continues to reach it. A safety valve on outlet header, set somewhat lower than the drum valve safeties, does the trick. Some steam will continue to flow through the superheater, thus keeping it cool. You may also install a power control valve on the superheater header. Set this valve to operate at a pressure slightly lower than the regular superheater safety valve, and provide a shutoff valve below it so it can be maintained without shutting down the boiler.

Water carryover from the boiler is another factor that can cause rapid failure of superheater elements. Sometimes solids in this water dry out into nonadherent globules that do not attach themselves to the superheater tube walls, but at other times a layer of concentrated material builds up, and insulates the tube metal from the cooling action of the steam.

Even a very thin layer is dangerous; it may dissolve as steam condenses to water while the boiler cools. Then, when the boiler is refired, the solids concentrate in the lowest portions of the tubes where the heavy deposits soon cause elements to fail from metal overheating.

Preventing carryover. Proper feedwater conditioning to prevent foaming or priming is important. In addition, joints of the steam separators, baffles or washers in the boiler drums must be steam tight to prevent spray leakage into one or more superheater elements, causing eventual damage. Assuming a certain minimum leakage, or carryover, the lower the concentration of solids in the boiler water, the less the deposit in the superheater or on turbine blades.

Water level in the steam drum is often important in determining amount of carryover, and if drain lines from the steam separating baffles are improperly or inadequately sealed, boiler water may be drawn up with the steam. Boiler drums and steam cleaning internals need careful inspection before operation and at each outage thereafter, to maintain maximum steam purity.

Superheater-element materials. Temperature of the steam inside a superheater element usually determines the skin temperature. But if an unusually high mass flow or radiation acts on it, the usual 50-100 F elevation above steam temperature may be doubled. As a rule, boiler manufacturers use a variety of alloys to meet temperature conditions expected.

Low-temperature superheaters and the first portion of high-temperature elements, up to about 800-F skin temperature, use carbon steel. Up to about 900-F skin temperature, carbon-molybdenum tubing is normally good. For hotter portions of the superheater elements, with skin temperatures up to 1100 F or above, chrome-moly or some similar heat-resistant alloy is used.

The weakening of a given metal accelerates rapidly once you pass its normal permissible maximum temperature. Design safety factors may permit only a gradual enlargement or elongation of the tube over a period of time, but if the elements are overheated several hundred degrees, rapid failure may result.

Some engineers put small lugs or tram marks on elements exposed to high temperature to permit checking enlargement or elongation periodically. But it's difficult to make these measurements accurately.

Economizer operation. In starting up a boiler where flue gas cannot bypass the economizer it's most advisable to start with low-water level in the drum, and either feed water steadily at a very low rate, or intermittently feed a small amount. This prevents boiling in the economizer, avoiding heavy water hammer and damage to lines or valves that such boiling may cause.

Occasionally, excessive or localized high-rate heat absorption in the economizer causes trouble when boiler is operating at a high rate. Steam released in drum feedwater trays may spray and spatter enough to produce symptoms of excessive carryover in the steam leaving the drum.

For best operation, install means for determining water temperature rise and pressure drop through the economizer, along with corresponding data for the flue gas. Records of this information taken during first starting operations are very handy in determining best procedures for regular use.

Data, taken when economizer surfaces are clean, also give a basis of comparison for economizer performance and efficiency during subsequent operation. In addition, it's advisable to record flue-gas analysis to tie in with the gas-temperature and pressure-loss data.

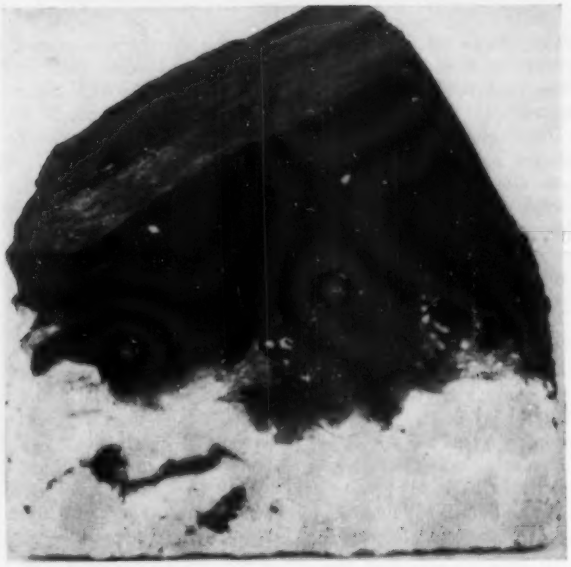
Formation of steam in some or all economizer elements may cause overheating of the element metal and eventually result in failure. A rather close initial check of gas and water distribution through an economizer is, therefore, warranted.

Nonretractable sootblowers. In the cooler sections of coal- and oil-burning boilers and their economizers, rotating,

(*Continued on page* 200)

By J O COLLINS, *Process Division*
and W A HERBST, *Research Division**
Standard Oil Development Company

Why the present interest in ash of residual fuel oil? The answer is found in higher temperatures, making modern power-generating equipment more sensitive to ash, and in recent changes in ash content of fuel oil



BLACK, GLASSLIKE SLAG results from fusion and chemical reaction taking place between residual-fuel-oil ash and brick

How ash of residual fuel oil affects

► WHY DO THE EFFECTS of vanadium and other ash constituents in fuel oil now loom large in the thinking of equipment designers and power-plant operators? The answer starts with a clear understanding of just what we mean by "fuel oil" and how it's produced.

We're dealing here with residual fuel, also commonly known as bunker C, or No. 6 oil. This may be defined as a liquid product that contains the nondistillable portions of petroleum. These residues may derive from crude distillation, cracking operations, or redistillation of distillate products.

Domestic demand for residual fuel runs about half that for motor fuel and slightly more than the total of kerosene, gas oil and distillate fuel. Largest single user of residual fuel is industry, followed by the marine trade. Electric utilities and space heating come next, at about 13% each.

Ash constituents. By its very nature, residual fuel contains the nonvolatile ash-forming constituents in the original crude. Ash materials may also come from other sources: (1) Oil-soluble compounds in the crude itself. (2) Water-soluble compounds (usually salts) occurring in solution in water associated with the crude. Processing leaves these compounds in the residual fractions as finely divided suspended solids. (3) Ash compounds from corrosion caused by reaction of naphthenic and other acids in the crude with metal tanks, pipelines and refinery equipment. (4) Contamination with scale, water, etc. (5) Caustic, carbonates, etc, injected into distillation equipment to control corrosion or to neutralize acids.

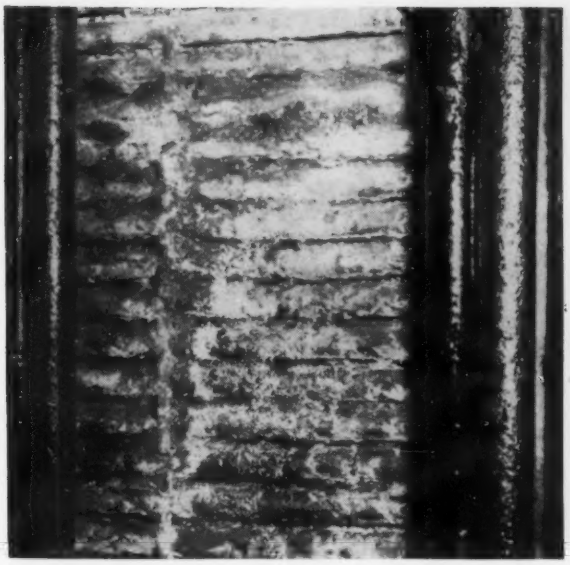
Trace elements. Investigators disagree on how such trace elements as vanadium, nickel and other metals occur in petroleum. It has been pretty well established that they are in oil-soluble form, cannot be extracted by water washing. Some proof has been offered that these metals occur in complex metallo-organic compound, such as a porphyrin, a combination of carbon, hydrogen, sulfur and metal. The metal complexes appear to occur in higher boiling fractions of the crude, particularly in the asphaltic portions. They are considered to be nonvolatile although there is some evidence of their ability to be distilled, at least in part. Regardless of exact form, there is almost complete agreement that such compounds are very difficult to remove.

To see what major oil-soluble metal constituents are present in crude oils, and their concentrations, careful analyses were made on 25 samples of U.S. and South American crudes with ash contents varying from less than 0.001 to about 0.06%. These show that ashes from all crudes may be expected to contain sodium and vanadium, often in concentrations above 10%. Most crudes contain nickel and iron. But in only about one-tenth of the samples did nickel occur above 10%, and only about one in eight showed more than 10% iron in the ash. Silicon and aluminum show up in a number of crudes, usually in small amounts, while calcium and molybdenum occur infrequently and always below 1%. Numerous other metals are found, but only in concentrations below 1%.

Ash content of fuels derived from various crudes vary, depending on yield and method of processing the crude. A typical fuel oil may have an ash content of about 0.08%, with a normal range of about 0.02 to 0.15%. In other words, from less than 0.1 to about one-half lb per bbl of fuel.

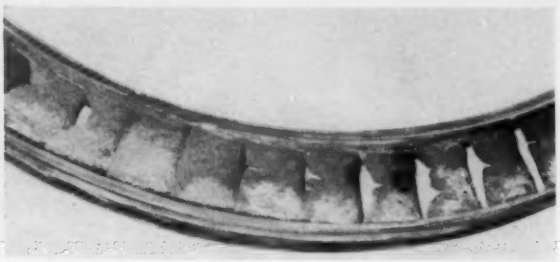
Why important now? Since vanadium and sodium have always been present in the majority of fuel oils, it's logical to ask why the presence of these materials has become an increasingly important factor in power-plant

*Adapted from paper presented before the Boston Section of the American Society of Mechanical Engineers.



FLAKY DEPOSIT on boiler superheater shown by removal of tubes. Deposit from fuel ash high in sodium, low in vanadium

HARD, BLACK, CRYSTALLINE deposit on tube is ¼ in. thick. It results from fuel ash high in vanadium but low in sodium



HIGH-TEMPERATURE CORROSION on gas-turbine first-stage nozzle partition after operating with oil 1052 hr, at 1300 F

high-temperature boiler operation

operation. One major contributing factor is the trend to higher pressures and temperatures, reduced boiler size for a given capacity. These mean more severe temperature conditions, smaller clearances between tubes. And the advent of the gas turbine, with its need for high temperatures, has been another factor focusing attention on ash content and composition.

Supply changes. Concentration of ash constituents in fuel oil has, in general, increased in recent years. Increased demand for distillate products has meant a decline in yield of heavy fuel oil, particularly from domestic crudes. Thus ash content of original crude is concentrated in a smaller quantity of residual fuel.

Greater amounts of heavy fuel have been imported, mostly from South American sources, which are, in the main, inherently higher in vanadium content. These factors, and probably others, increase problems from ash.

What are the effects of fuel-oil ash constituents on high-temperature power-generation equipment? The broad term "ash constituents" is used deliberately because it is difficult to separate the effects of vanadium alone from those of other ash constituents, such as sodium.

Effect on boiler refractories was encountered years ago when boiler design included more brickwork than now. This was particularly true on some marine boilers where fireboxes were small and flame impinged on brickwork, resulting in wall temperatures of 2800 F or higher. Damaged bricks were glazed and walls were marked by vertical channels where rivulets of molten slag ran down.

Analysis of typical refractory slag and fuel-oil ash indicates that ash reacts with refractory and lowers its fusion point well below that of unreacted refractory and below temperatures that may be met in furnace walls.

Studies of fusion points of mixtures of vanadium pentoxide, sodium vanadate, alkaline and alkali earth-metal salts with firebrick show that at high vanadium concentration, such as would occur at the face of the brick, fusion point of firebrick-vanadium compound is lowered appreciably. Slag formed with sodium vanadate appeared to be more reactive with the kaolin-alumina base than that formed with the vanadium-pentoxide-brick mixture.

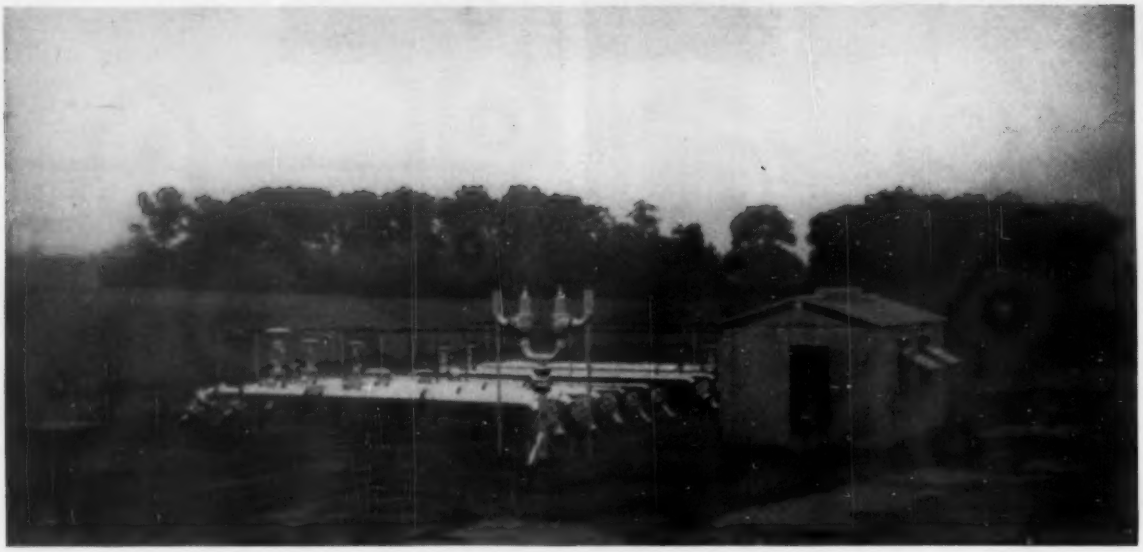
In absence of vanadium, certain sodium compounds (notably sodium sulfate and carbonate) were found to lower fusion point of firebrick to a greater extent than calcium, magnesium or potassium compounds. But the reaction products showed no effect on the kaolin-alumina base, indicating absence of a chemical attack by the slag, such as occurred with the vanadium compounds. This doesn't mean these reaction products are harmless—they can promote brickwork damage by spalling.

Several remedies can be applied where this problem is particularly severe. Laboratory studies indicate high-alumina brick are more resistant to attack from petroleum ash than conventional brick. Magnesia brick is also suitable, but only the most severe cases justify the higher cost. Improvement of combustion to eliminate flame impingement minimizes brickwork damage. Cooling of the brick is sometimes practiced to reduce oil-ash effects.

Boiler deposits. In high-temperature high-pressure boiler operation, oil ash may have two major effects aside from those on refractories: slagging or fouling of tubes, and corrosion of metal at high temperature. Let's look first at slagging, fouling or ash deposition.

Most critical area is generally in the superheater, where tubes are close and tube-metal temperatures are highest. We have observed two distinct types of deposit. One is hard, black, crystalline,

(Continued on page 218)



1 This gas-metering and regulation station typifies installations for steam-generating plant service. Prefabricated building protects instruments. The almost complete symmetry comes from having regulator approaches as long as meter runs

How to buy and measure natural gas

By **CHESTER S BEARD**
Research & Development Engineer
Foster Engineering Company

► NOW THAT a greater number of branch-transmission lines are being connected to transcontinental lines and more of these main lines are being installed, natural gas has become more generally available. Gas is often cheaper than other fuels, and for this reason should always be considered when designing new steam-generating plants. Ease of use, less complicated equipment and controls, and clean operation favor this consideration.

To best decide about gas for your plant, first learn something about the terms under which it is supplied. Then, at the design stage and, later, during operation, you will find it handy to know something about the metering and regulating station in your gas-service line.

Terms. Type of contract you may get depends on conditions in your area. To start with, a variety of relations exist between consumer and supplier. Your plant may receive gas through a service line connected directly to the main transmission line with no other consumer taking gas from your line. In this case you buy from the transmission company. With this setup, you normally get a continuous supply.

Or your gas contract may be with a distributing company. Here the company may serve a large area from a branch line connected to the main transmission line. The contract a steam plant gets depends on other consumers being supplied by the distributing company. Sometimes it's possible to get a firm contract giving normally continuous gas supply. The more usual contract, however, furnishes gas on either a dump or interruptable basis.

A dump contract supplies gas on a continuous basis during specified summer months. Since it allows the distributing company to sell gas during the off season when domestic and other loads are light, the dump contract usually offers the lowest service cost to those who can use it.

The interruptable contract gives the consumer gas the year around, but permits the distributing company to stop supplying it on one- to 24-hour notice. Actual days of service during the year depend on other consumers in system.

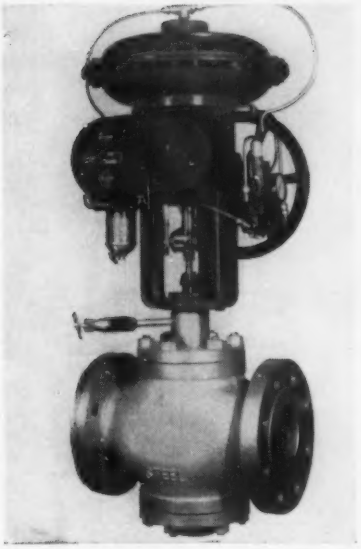
A secondary fuel system is required when getting gas on a dump or interruptable basis. But with these types of contracts the price advantage may overbalance cost of a secondary system.

Supplying company is normally committed to deliver gas at a minimum pressure, but does not usually guarantee to stay below maximum. The contract generally agrees on a minimum heating value.

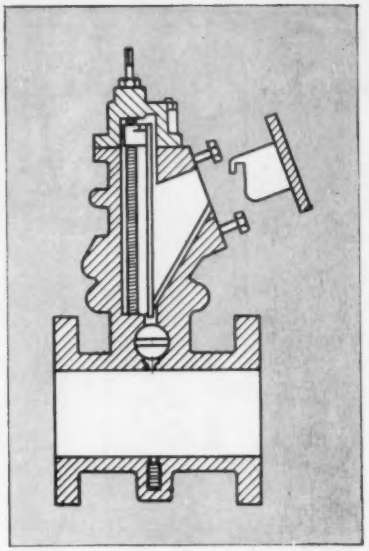
In any case, the gas service line to your plant will have a metering and regulating station. And the equipment in this station depends on the contract and conditions in the transmission line. The company supplying the gas owns this metering station.

Metering station location is somewhere on the service line to the steam plant. As the distributing companies normally feel that any gas loss in the service line due to breakage or leaks is the consumer's responsibility, the metering is usually placed close to the transmission line.

In at least one case, though, where

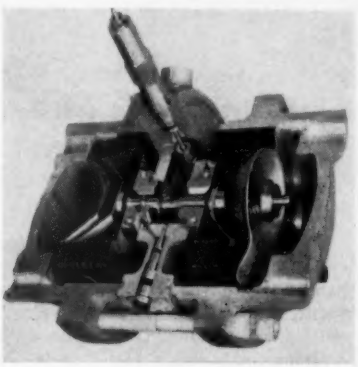


2 Diaphragm-actuated control valve uses air, valve - discharge gas pressures



3 Orifice fitting permits inspection of plate with meter run in operation

4 Mercury manometer is most commonly used differential measuring device



5 Bellows meter body is becoming popular for differential measurement

for your steam plant

the small-diameter service line is of welded construction and has no take-offs between plant and tie-in, the metering station is on the property of the steam plant it serves. The service line is about two miles long. This arrangement has the advantage of using steam plant personnel for chart changing, service, pressure changes and incidental operation.

Relatively few metering stations require continuous attendance. They need operating personnel only to change charts, make adjustments or service equipment. For this reason, they are located so personnel can get to them readily in all kinds of weather. Weather damage and curiosity of neighbors are also considerations in locating the station. Future expansion in the area of the service line to your plant may require tie-ins to that line. Possibility of such expansion is taken into account in locating the metering station so there will be no take-offs between your plant and the station.

Some communities are considering ordinances restricting gas pressures to a maximum of 100 psig in lines through their area. This would mean that either larger piping would be necessary, or the metering station would have to be outside the restricted area. One factor must be balanced against the other before the station location is decided. In a populated area, building ordinances or just plain customer relations require that a station be attractive.

Equipment needed in a metering station varies over a wide range depending on contract conditions, the amount of gas being metered and controlled, temperature conditions, etc. Principal equipment is discused below.

Pressure control. Variation of fuel load during the day in most steam plants requires something more elaborate than a hand valve to give desired gas pressure at the plant.

Pressure-control valves with various types of actuators are used. The simplest pressure regulator consists of a globe valve positioned by a diaphragm actuator opposed by a spring. Use of this regulator in large sizes at high pressures is limited because of large unbalanced forces across the valve and variations in power available from the diaphragm-spring combination.

For larger valves small pilot valves with accurate control characteristics are used to supply positioning pressure to diaphragm topworks. Controlled gas pressure operates pilot valve.

Control is refined further by having controlled-gas pressure position a bourdon tube, which operates a relay. Relay varies low-pressure loading of control-valve actuator, which is sized to position the valve under all operation.

Control-valve assembly, Fig. 2, has both an integrally mounted controller and a side hand wheel for emergency use. Hand wheel gives positive action and does not interfere with automatic operation of valve.. Although the actuator may be the spring-loaded type, Fig. 2 shows springless topworks. Controller output varies air pressure to top and bottom of the diaphragm to obtain very large positioning forces for control valve.

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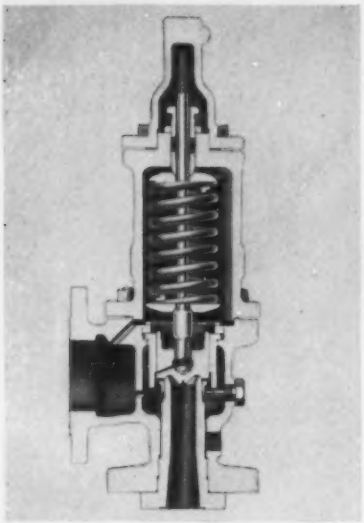
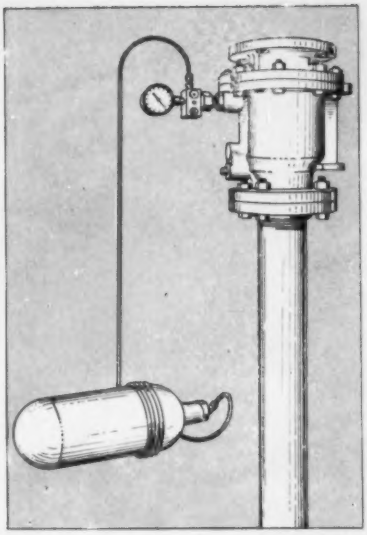
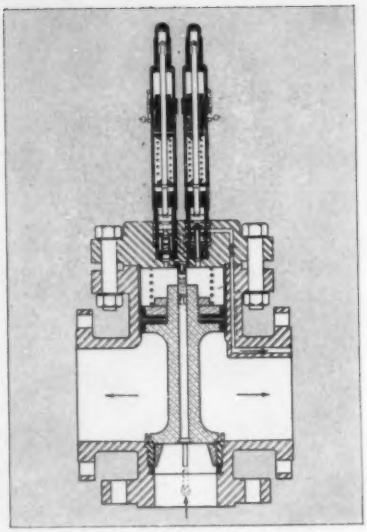


6 The relieving capacity of this relief valve varies with the overpressure



7 Constant rate of opening characterizes this rubber-sleeve relief valve



8 Two pilot valves permit close setting of the valve opening and closing

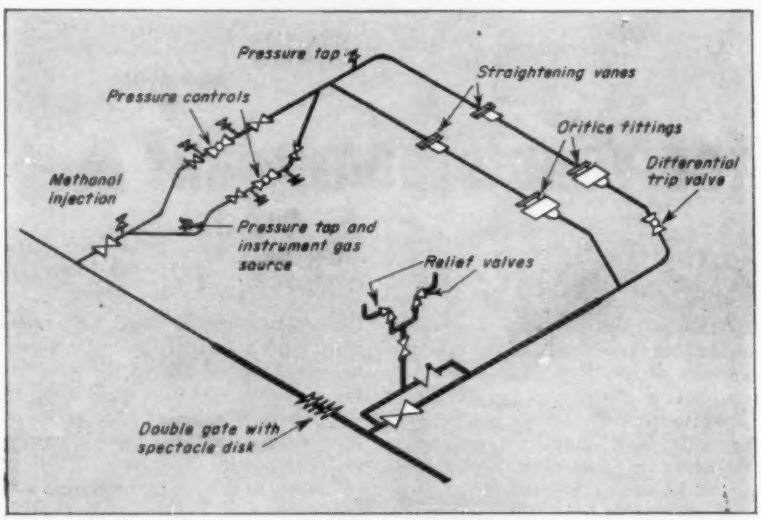
Relief valves can cut costs of low-pressure pipe, valves

Measuring equipment. Differential meters are normally used for steam-plant service. An orifice, flow tube or venturi tube, produces pressure differential in the gas line. Orifice plates are most commonly used. Fig. 3 shows an orifice fitting that allows inspection of the orifice plate without having to bypass the meter run. You can install orifice plates between flanges, but this requires bypassing or shutting down for inspection.

Mercury manometers, like the one in Fig. 4, are most commonly used for measuring and recording pressure differential across the orifice. A float rises and falls with the mercury on change of differential pressure. Motion of the float actuates pen on recording chart.

The bellows meter for measuring differential, Fig. 5, is gaining popularity. Mechanical linkage shown transmits motion to pen for recording. This meter has decidedly less zero shift due to temperature changes.

To get gas flow in terms of contract conditions, temperature and pressure of gas must be available. Recording pressure gages and thermometers give this information on a 24-hour basis. Flow in cubic feet can be obtained with pressure differential across orifice, static pressure, temperature, gas specific gravity.



9 Metering-station piping arrangement insures protection to low-pressure lines and valves at all times. Differential trip cuts in added meter run when needed

Relief valves. Extreme care must be taken so that piping and pressurized components of metering station and service line to plant are not subjected to more pressure than they are designed for. Relief valves protect this piping.

Until lately safety valves of gas line were like those of steam boilers.

Relief valve in Fig. 6 gives varying relieving capacities as gas-line pressure increases. On initial opening, valve allows 30% of maximum flow to pass. With further increase in line pressure, valve continues to open until, at 5% overpressure, 65% of maximum flow will pass. Above 5% overpressure, valve opens to allow 90% flow; at 10% overpressure, maximum flow is obtained.

Certain antiquated requirements have been relaxed as a result of recognizing the dependability of new design.

A constant-rate-opening relief valve is shown in Fig. 7. Bomb is loaded with gas at the desired relieving pressure for the gas line. Bomb pressure is piped to one side of a rubber-sleeve valve and gas-line pressure acts on its other side. When gas-line pressure gets above bomb pressure, rubber-sleeve valve opens, relieving overpressure in gas line. The valve is designed so con-

(*Continued on page* 210)

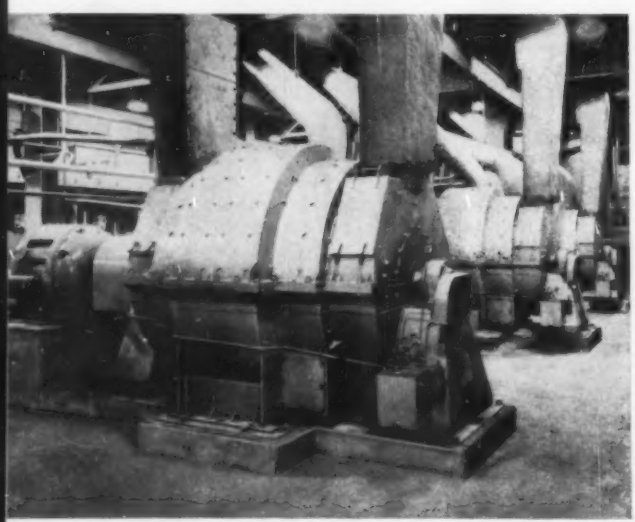
Typical turbine-generators with capacities 30,000 kw and over

Turbine rating, mw	30	40	50	60	75	100	125	150	175	200	250	300
Generator rating, mva	38.4	51.2	64	76.8	96	128	160	192	224	256	320	384
Throttle conditions	Maximum initial throttle temperature											
Single casing, 3,600 rpm												
400–600 psi	900	900	–	–	–	–	–	–	–	–	–	–
601–850 psi	950	950	–	–	–	–	–	–	–	–	–	–
851–1,450 psi	1,000	1,000	–	–	–	–	–	–	–	–	–	–
Tandem-compound, double flow, 3,600 rpm												
250–400 psi	–	900	900	–	–	–	–	–	–	–	–	–
401–600 psi	–	900	900	900	–	–	–	–	–	–	–	–
601–850 psi	–	950	950	950	950	–	–	–	–	–	–	–
851–1,450 psi	–	1,000	1,050	1,050	1,050	1,050	1,050	1,050	–	–	–	–
1,451–1,800 psi	–	–	–	1,050	1,050	1,050	1,050	1,050	–	–	–	–
1,801–2,400 psi	–	–	–	–	–	–	1,050	1,050	–	–	–	–
1,250–1,450 psi, 950 or 1,000 F reheat	–	–	1,050	1,050	1,050	1,050	1,050	1,050	–	–	–	–
1,451–1,800 psi, 950 or 1,000 F reheat	–	–	–	1,050	1,050	1,050	1,050	1,050	–	–	–	–
1,801–2,400 psi, 950 or 1,000 F reheat	–	–	–	–	–	1,050	1,050	1,050	–	–	–	–
Tandem-compound, triple flow, 3,600 rpm												
851–2,400 psi	–	–	–	–	–	–	1,050	1,050	1,050	1,050	–	–
1,250–2,400 psi, 950, 1,000 or 1,050 F reheat	–	–	–	–	–	–	1,050	1,050	1,050	1,050	1,050	–
Cross-compound, single flow, 3,600/1,800 rpm												
1,250–2,400 psi, 950, 1,000 or 1,050 F reheat	–	–	–	–	–	–	1,050	1,050	1,050	1,050	1,050	–
Cross-compound, double flow, 3,600/1,800 rpm												
1,250–2,400 psi, 950, 1,000 or 1,050 F reheat	–	–	–	–	–	–	–	1,050	1,050	1,050	1,050	1,050
Cross-compound, quadruple flow, 3,600/3,600 rpm												
1,250–24,00 psi, 950, 1,000 or 1,050 F reheat	–	–	–	–	–	–	–	1,050	1,050	–	–	–
Single casing, 1,800 rpm												
250–600 psi	–	–	–	–	–	900	900	–	–	–	–	–
601–1,450 psi	–	–	–	–	–	950	950	–	–	–	–	–
Tandem-compound, double flow, 1,800 rpm												
601–850 psi	–	–	–	–	–	–	–	950	950	950	–	–
851–1,450 psi	–	–	–	–	–	–	–	1,000	1,000	1,000	–	–

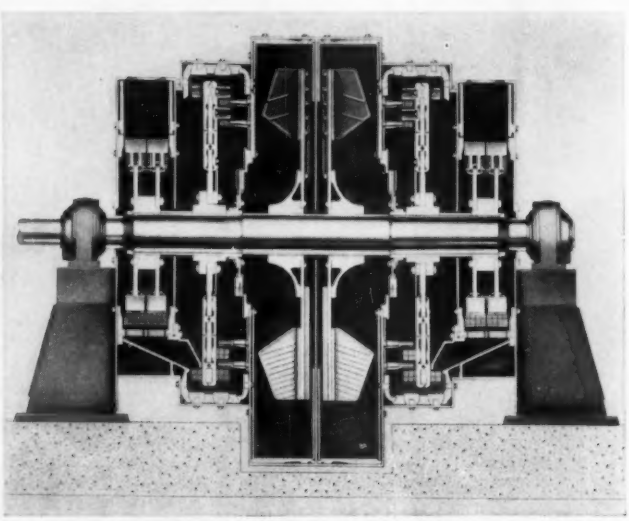
These condensing turbines are for back pressures up to 3.5 in. hg abs. From AIEE Paper No. 54–508 by E. H. Krieg, Stone & Webster Engineering Corp.

Here's *positive proof* that tungsten carbide faced pulverizing elements in Riley "50" Pulverizers can *take it!*

Maintenance of Riley "50" Pulverizers is simple. Engineer easily removes and replaces pulverizing pegs.



Two batteries of three Riley Duplex "50" Pulverizers each serve two 700,000 lbs./hr. Riley Steam Generating Units at Albright Station. Monongahela Power Co. — The Potomac Edison Co. Every twenty-four hours approximately 3.5 million pounds of deep and strip mine coal containing 720 thousand pounds of ash and shale are pulverized in these rugged units. Required fineness is maintained despite the extremely abrasive materials in the coal and the large quantities of coal pulverized.



At Albright Station, engineers report that even when water actually runs out of the pulverizer feeders, the flash drying characteristic of the crusher-dryer sections (extreme ends of illustrations) dries coal so efficiently that pulverizer capacity is unaffected. Foreign particles and tramp iron are also rejected in these sections. The design of Riley "50" Pulverizers assures quiet, vibrationless operation. Riley "50" Pulverizers are available in capacities from 5,000 to 50,000 pounds per hour.

. . . this Tungsten Carbide faced moving peg was removed from a Riley "50" Pulverizer that had pulverized during a fourteen month period 130,000 tons of West Virginia strip and deep mine coals *averaging 20% ash content.*

unretouched photographs actual size

and it's still good for many more tons!

Compare . . .

Here is a brand new peg . . . notice how little tungsten carbide on the used peg (above) has worn off . . . actually less than 1/3 of the tungsten carbide facing. Low maintenance is one reason why Riley "50" Pulverizers have been installed by so many industrial and utility companies.

Your Riley Representative can furnish you with complete information about the Riley "50" Pulverizer or write direct to Riley Stoker Corporation for catalog.

RILEY *Stoker Corporation*

WORCESTER, MASSACHUSETTS

Boston New York Philadelphia Buffalo Washington Pittsburgh Cleveland Detroit Chicago Cincinnati Charlotte New Orleans
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COMPLETE STEAM GENERATING UNITS

AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITIES, INDUSTRIAL POWER AND HEATING PLANTS

—with Chase® Copper Bus Conductors!

Chase Square Copper Tube Bus Conductors are *ventilated* so more heat is *dissipated.* Result: current-carrying capacity is increased *up to 20%*. They'll handle even heavy short-circuit currents—and are strong enough for use in longer unsupported lengths. Call your nearest Chase Warehouse or Sales Office.

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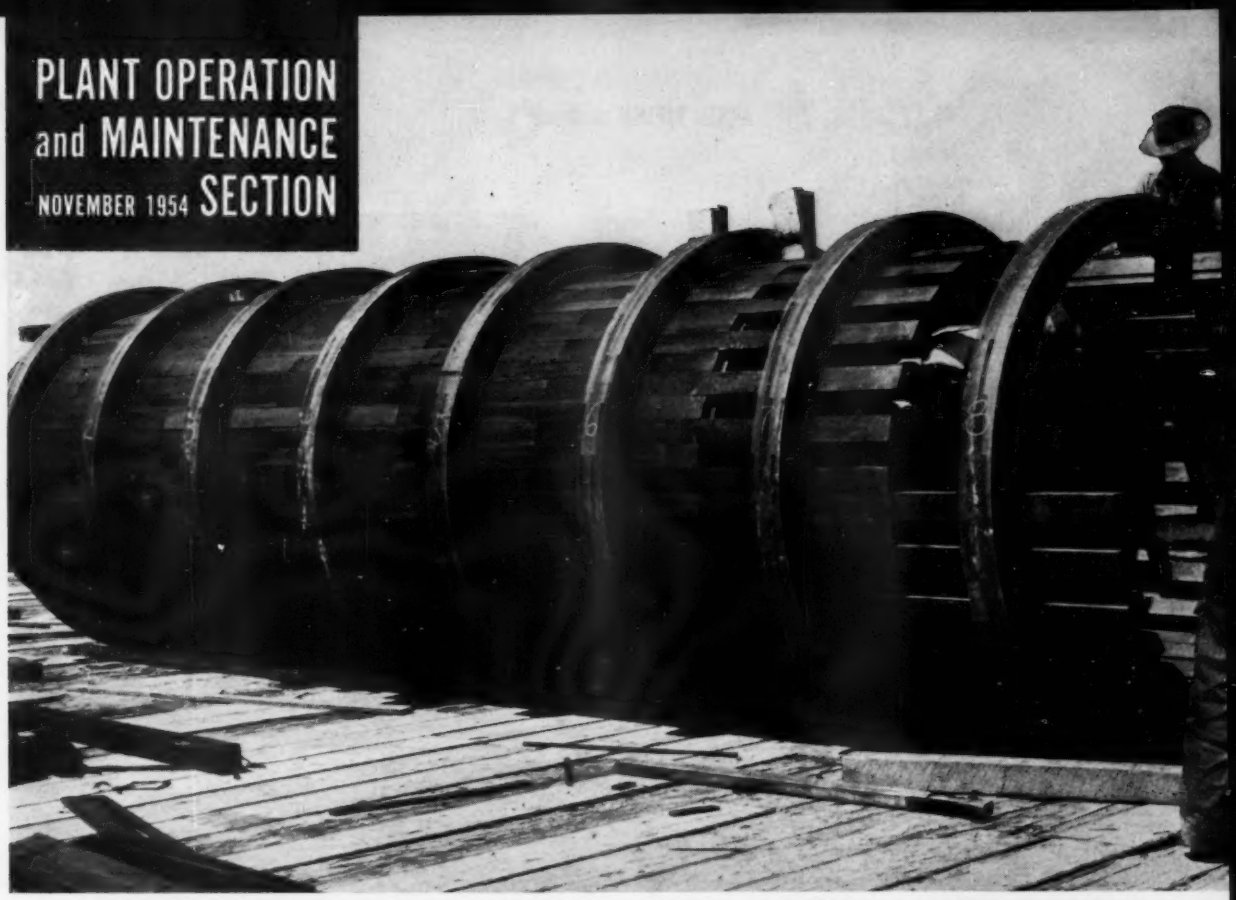


THIS PIPE goes together in small units, can be shipped and built wherever there's a level working place

NOW, lock-stave wood piping carries highly corrosive liquids

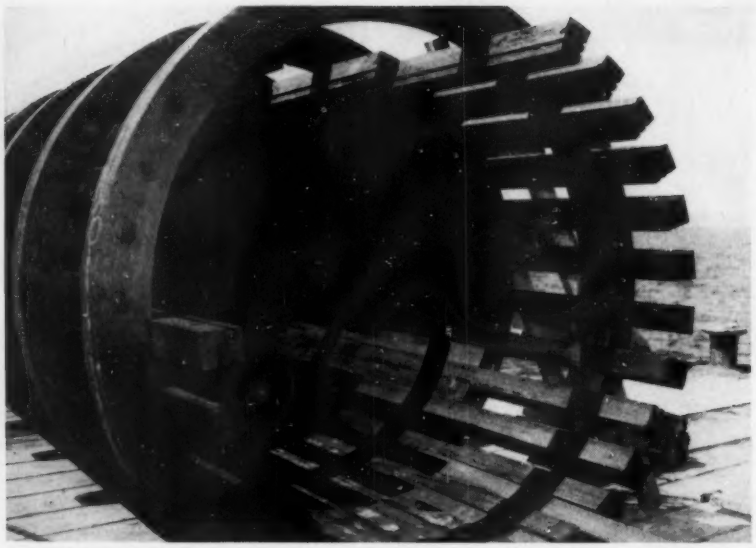
► WOOD—AND ONLY WOOD—piping is best suited for many jobs because of adaptability, economy and proved service life. For one thing, there is no hard and fixed design of a wood pipeline. For waste lines, wood often takes the place of stainless steel or ceramic pipe—with the advantage that it can be installed in unstable ground where settlement is anticipated.

Large lock-stave pipe shown was developed by Chief Engineer Ray C Hansen of Brooks Lumber Co, Bellingham, Wash. The 60-in.-diameter pipe carries highly corrosive pulp-mill waste liquor under the Snohomish River in Everett, Wash.—out to a disposal area, into salt water.

Pressure-treated with creosote, Douglas fir was best all-round solution of this problem for these reasons: It (1) has strength to resist pressures (2) lasts indefinitely without pitting, scaling or tuberculation (3) has high acid-resistance and (4) has the resilience and flexibility to conform to normal curvatures common to river-bed installations.

Turn page

REINFORCING HOOP is all wood, held together with waterproof glue and pegs



STRENGTH, elasticity and immunity to corrosion are obtained by combining wood, pressure-treatment and engineering know-how in this giant mile-long piping design

Settlement, unstable ground,

Construction. Everett job was assembled from prefabricated staves and hoops that had been pressure-creosoted to a retention of 10 lb per cu ft.

Concrete ballast rings were placed in position between each pair of laminated-wood hoops for weight to sink and hold pipe in place. Seven sections, each 140 ft long, were built on the dock and then placed on barges for transport to site of installation. Sections were lowered into water and bolted together so tapered-end joint made them tight.

Pipe staves were run to pattern from short-length lumber to make assembly easier. Each stave has two daps into which the hoops fit, and the staves are alternately spliced at hoop points. Each stave is thus double-locked into place. Staves are joined end to end with ½-in. marine plywood-tongues or splines.

Glue used is waterproof Cascophene resorcinol resin, made by chemical division of Borden Co. As for glue holding up, average breaking strength was 78,000 lb when tested with three 20-ton hydraulic jacks as shown. Almost all breaking was in wood itself—very little in glue line.

Costs. There is no way to compare costs of this pipe with other materials at present. Reason is this wood pipe is designed to handle highly corrosive liquids, such as wastes from chemical plants. Only other material for a pipeline to handle similar corrosive liquids would be some of the expensive stainless steels or ceramics, as mentioned before. So all such wooden piping to date has been specially built for a specific job.

Pipe is not stocked. In each case, the project is studied because the requirements vary widely. For instance, one project may have to operate under 5 psi, while others may run up to much higher pressure. Then, again, field conditions may dictate some modification in structural design.

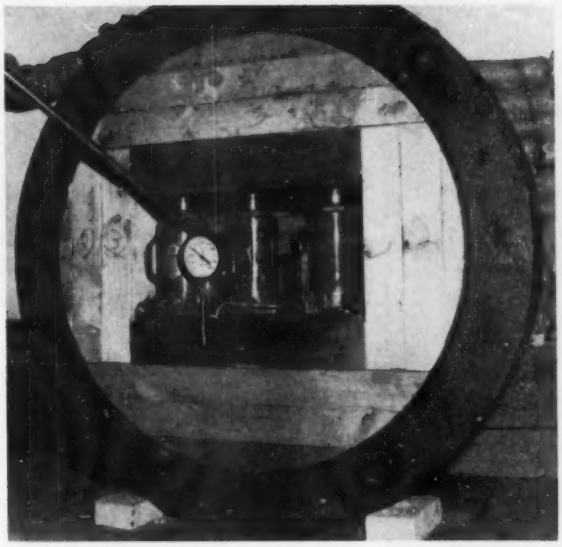
One thing to bear in mind is that piping is permanent and should be used only where some initial leakage is not objectionable.

This firm does manufacture the conventional wood-stave pipe in all sizes from 2 to 20 in. diameter, which is far more widely selected in various industries. One common use around power plants is for penstocks and water-supply lines, as well as outfall sewers.

One interesting wooden pipeline just completed is the main water-supply line for the new Ketchikan Pulp Co's mill at Ward Cove, Ketchikan, Alaska. This is a continuous wood-stave pipeline, 60-in. inside diameter and over two miles long. It leads from water-supply source to water-filtration plant. There are also other wooden lines of same design leading from filtration plant to the pulp mill.

Water supply and sewer lines are wood at Ketchikan. Reason for wood-stave piping for water-supply line was to deliver water from source of supply to point of use with its natural purity unchanged, no rust or corrosion contamination. Too, installation is permanent, with little maintenance needed. Pipe also holds up well under freezing conditions. Hot-and-cold pentachlorophenol preservative treatment of wood staves makes a clean, permanent job.

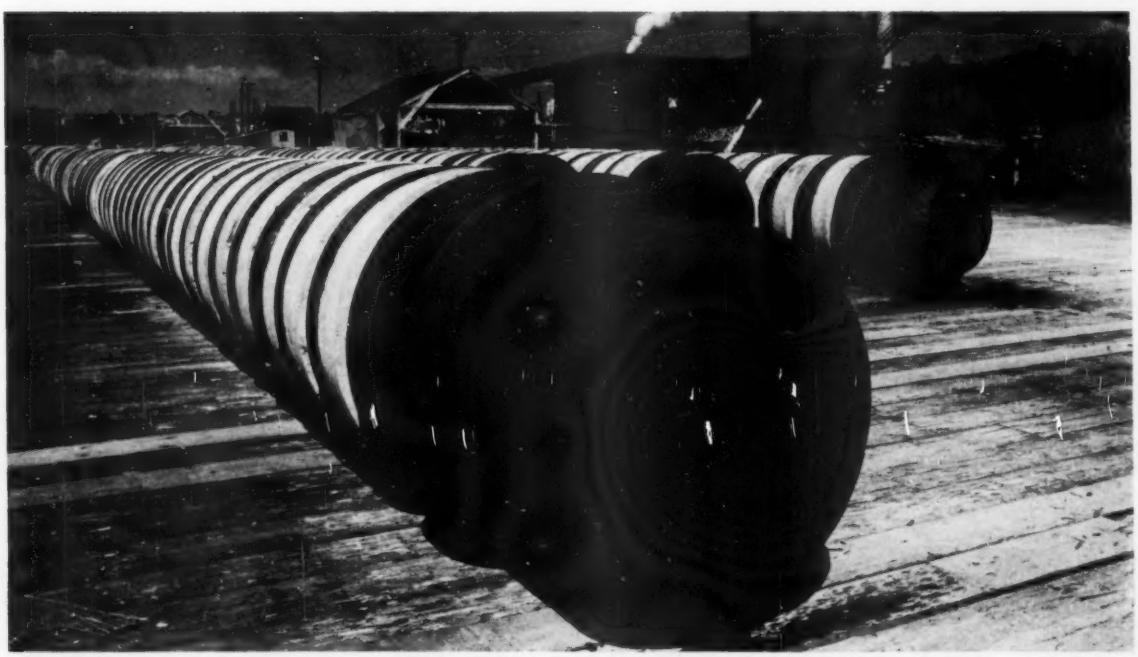
Future. There is a definite trend to wood pipelines where newer materials have been tried and failed. Douglas Fir has many qualities, such as acid resistance, strength, durability, and availability in long, clear lengths. That is why this material is reliable for constructing tanks and large piping.



RESISTANCE to outward pressure is tested. The hoop let go at 78,000 pounds. But only the wood gave way—the glue held

SECTIONS of pipe 140 ft long are laid, then divers join them under water before lowering into 15-ft ditch under water

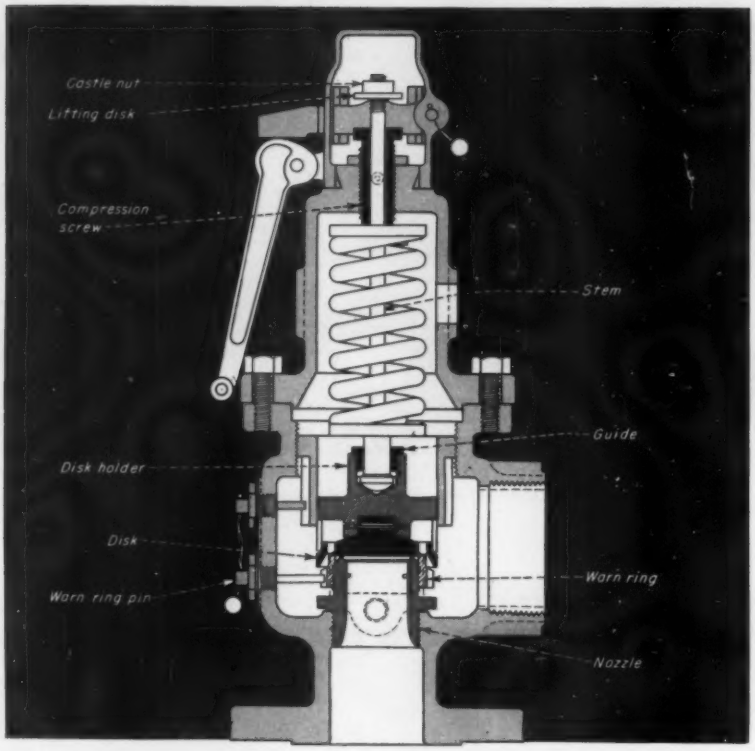
tuberculation, corrosion and pitting are licked

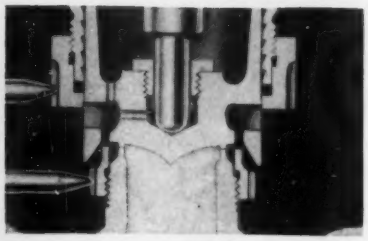


CONCRETE ballast rings are placed in position between each pair of laminated wood hoops—then piping is assembled through them. Ballast rings are for sinking pipe into place and for keeping it there, ready for movement to drop off here

OPERATORS' NOTEBOOK 80

Here's information on





CLOSED. Pressure is contained in throat chamber, no pressure on conical baffle

How valve works

► THREE TYPES of high-pressure steam-drum safety valves in general use are: (1) jet flow (2) nozzle reaction (3) huddling chamber. Jet-flow type was covered in Operators' Notebook 74, p 118-119, May 1954.

Nozzle-reaction type. In the opening phase of any safety valve, spring force keeping valve closed must be counteracted by a greater force on pressure side. But as disk rises, spring load increases from compression. So total force needed to obtain high lift must also increase. In nozzle reaction valve

How to Overhaul

1 Remove seal, yoke pin, cap, yoke, castle nut and lifting disk from valve

2 Measure compression screw height to save time when reassembling valve

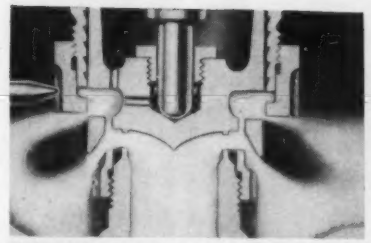
3 Loosen the locknut, screw the compression screw out of the valve bonnet

7 Measure distance from top of disk-holder guide to top of the valve body

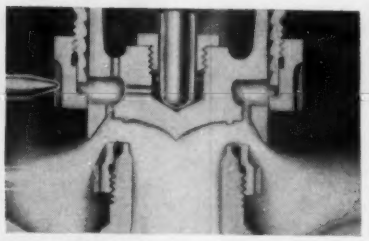
8 Remove warn-ring pin and also the disk-holder guide pin from valve body

nozzle-reaction safety valves

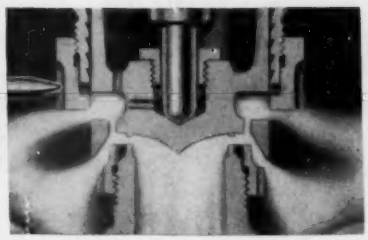
By STEVE ELONKA, *Associate Editor*



THREE-QUARTERS OPEN while popping. Partial pressure is on the conical baffle



FULL OPEN. Full pressure against enlarged baffle area, full reactive forces



HALF CLOSED. Pressure is against conical baffle on a rapidly diminishing area

shown, energy is produced by a conical baffle skirting the disk. This baffle causes lifting energy to be greatest at or near end of lift, thus giving full-bore lifts or greater at low accumulations.

Opening. As valve opens, steam escaping across seats impinges against conical baffle—then steam also acts against additional in-between areas. This large increase in head-pressure area gives sudden upward force, creating "pop" action. Initial force is increased by dynamic force of jet from nozzle—and impinging against disk face. This force increases rapidly with the flow.

Disk rises quickly from these forces, which constantly increase from increased velocity and with help of enlarging baffle area. Thus port orifice closes almost instantly.

At the same time, another lifting energy source comes into play. Conical baffle turns fluid jet downward, giving thrust-effect as in steam-turbine blades. This reactive force takes up rising compression load of spring. At usual overpressures of 3% for steam, 5% for gases, 25% for liquids, reactive force quickly lifts disk full-open.

Closing. System pressure-drop is usually gradual, with disk falling slowly at first. Jet tends to hold disk open much longer than needed. In this valve, a new control principle comes into play.

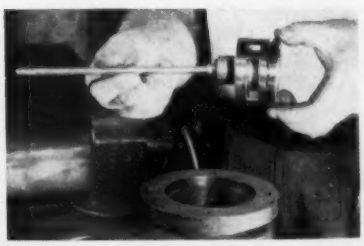
As disk falls in response to system pressure-drop to about 75% of full-open position, ports begin to vent pressure under the baffle. This cancels part of reactive force holding valve open. At same time, decreasing pressure under baffle works against a constantly reducing baffle area. Finally, total upstream forces become less than spring force—and disk closes sharply from about 50% of its rated lift.

When this or any safety valve needs overhauling, it's best to return it to manufacturer. If you must repair valve yourself, follow instructions carefully.

Photos, Courtesy J E Lonergan Co

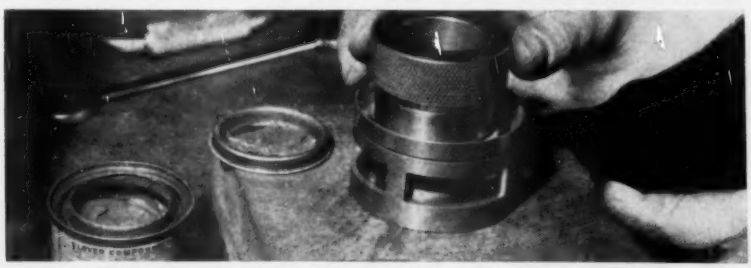
4 Mark warning ring with chalk so you can establish same setting later on

5 Bonnet is not under spring tension now; remove body bolts, lift bonnet



6 Remove stem with disk and holder. Disk floats in holder, no misalignment

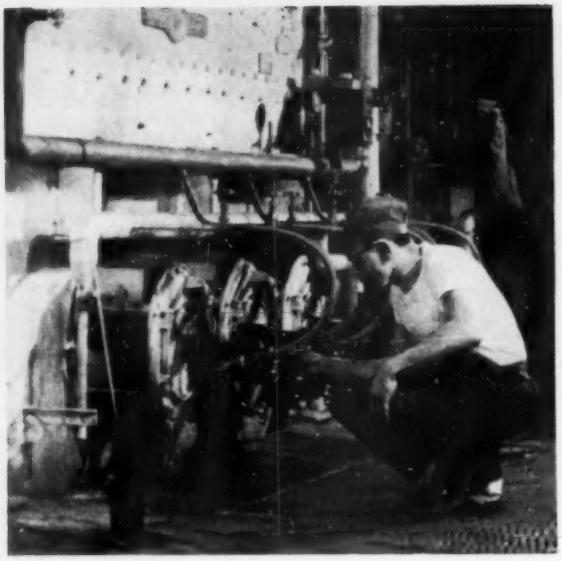
9 Screw out disk-holder guide. With special tool, remove the steam nozzle



10 If light imperfections on seat or disk, tap in both with lapping block, shown. Remove disk from holder for this job. Never lap disk against seat; use the block

Second of two articles on
FUEL-OIL ADDITIVES

By A J WEBER, *Kemsol Products*



Keep your fuel-oil system sludge-free by knowing . . .

Today's additives: What they are,

► IF YOU SAY today's residual fuel oils aren't as easy to get along with as the straight-run products of the past, you won't get much argument. An article in September told why this is so—how troublemaking sludges form and what causes them. Now let's see what can be done to cure these headaches: Just what can an additive do? What's in a typical additive? How should it be used? When, and in what quantities?

Benefits. Any experienced operator can see and "feel" benefits of an additive. With a good one at work, sludge doesn't build up in tanks, lines, strainers. Carbon on burner tips and cups is less likely. You can hold output with a smaller and more constant flame.

Better atomization produces more complete combustion, and automatically results in improved heat transfer. Amount of combustible in soot is lowered. In one test, proper use of an additive reduced combustible in soot from 82 to 18% in one week.

What's needed to get such benefits? To start with, a good additive should be (1) easily applied in uniform doses, without complicated equipment (2) free of offensive odor, either by itself or in use (3) noncorrosive, nonexplosive and nontoxic (4) gradual in its dispersing action—if it works too fast, pipes and strainers clog. And it should be (5) soluble or miscible in all grades of fuel oil (6) stable, by itself and when added to fuel oils (7) burnable, but not so volatile as to evaporate from the fuel oil.

In addition, a good additive should be able to (8) emulsify water formed by condensation (9) inhibit sludge formation. Finally, (10) a high specific gravity is necessary so the additive won't float, but will penetrate. It goes without saying that it must be possible to produce an additive with all these qualities at a price low enough to make its use profitable.

Two basic types of additives are compounded of an active material in a carrier, or entirely of active material. The carrier type is often intended only for emulsifying water or dispersing sludge. Active material is usually a heavy viscous substance that's hard to handle by itself, so it's mixed with light solvents.

Additives consisting entirely of active material usually have two to five different ingredients, each with definite functions. *Solvents*, for example, dissolve sludge compounds and may also help prevent sludge formation. Solvents also carry the other ingredients making up the complete treatment formula.

Surface-active agents are another kind of ingredient in additives. Between one liquid and another, or between a liquid and a solid, the molecules supply a certain tension or attraction. At the surface of a liquid, this molecular attraction is mostly inward—we know it as *surface tension*. Where liquids, or a liquid and a solid meet, it's called *interfacial tension*. Surface-active materials, which alter surface or interfacial tensions, are used in small amounts—normally only 10 to 30% of total additive. Generally speaking, there are four classes of surface-actives:

Emulsifying agents form emulsions between two liquids that aren't soluble or miscible in each other. *Dispersing* agents "float" solids in liquids. This spreads part of the sludge in the good oil, which carries it through the system in suspension. *Penetrating* agents assist passage of treatment liquid through the fuel oil, and of emulsions into the mass of sludge. *Wetting* agents increase and improve the spreading qualities of a liquid over a surface that exhibits a repelling tension or force.

Other ingredients. Designed to counteract effects of combustion products, such as sulfur dioxide and trioxide, *anti-corrosive* agents are generally alkaline to neutralize any acids formed with moisture in flue gas. Their effectiveness is questionable.

Soot eliminators are compounds intended to lower soot ignition temperature, so it can be burned away. They're usually metallic salts, with copper salts frequently used. It's apt to take a lot to produce noticeable results. Good combustion remains the best way to insure clean boiler surfaces and flues.

Rust inhibitors are sometimes included in additives, even though some ingredients, like surface-active agents,

The only conclusive test of an additive is actual use in your plant...

Too many times, superficial tests build up hopes not warranted by later results. For example, putting some sludge on a dish and applying additive to show how it "dissolves" the sludge means little. In such a setup, amount of additive is many times greater than under practical conditions. And the "sludge" may actually be No. 6 fuel oil, which is a lot easier to dissolve than sludge. This kind of test has value only for limited comparative purposes: to show speed and completeness of action offered by different additives working on the same sludge, under the same conditions.

So, to find out how good an additive is, use it. Normally you need to apply a drum of the material before you can draw any satisfactory conclusion on benefits. Such an extended on-the-job trial is the only *conclusive* test.

But here are four simple tests that will help in "weeding out"...

1. Place a few drops of additive on a dish. If it evaporates in a few hours, it's too volatile.
2. Cover a sample of fuel oil with additive. After 30 min, turn dish sideways, so liquid can drain off. After it has drained, there should be no lumps or heavy oil remaining on the dish. If additive can't dissolve fuel oil completely, it won't get very far with real sludge.
3. Start again with fuel oil covered with additive, but add a drop of water after 30 min. If it sinks out of sight, or floats on the surface, the additive won't emulsify the water in a tank. If the water drop breaks up and mixes with oil and additive, treatment probably has an emulsifier. That's good.
4. Mix two ounces of kerosene or light No. 2 fuel oil with two or three drops of additive in a test tube. Then add a few drops of water and shake. If water breaks into small droplets, creating a cloudy solution, or sinks to bottom of test tube where it forms a single mass and then develops a white cast, an emulsifier is probably present. Because of absorption of water into the mixture, the color may disappear after standing. If the solution remains clear after shaking, or there are individual drops on the bottom of the test tube, emulsifying action of the additive probably isn't very strong.

what they do, how to use them

have rust-inhibiting tendencies. For example, emulsifying water as soon as it's formed helps to keep down rusting.

How to apply additives depends on whether you're starting with a system that's badly fouled, or whether you're making routine application to a clean system that you want to keep clean.

Badly fouled systems, where sludge has built up heavily, are usually pumped out to sludge level. Then add supplier's recommended dose to treat sludge only, usually about one gal of additive to 500 gal of sludge.

Next step in procedure is to fill tank with fresh oil carrying regular dosage of additive as an inhibitor. This mixture should be allowed to settle, giving time enough for treatment to disperse sludge. Where sludge accumulation is large, action is a sort of "wearing away." As additive is introduced in each delivery of oil, it slowly works away at the sludge pileup.

Agitation is important to help break up the sludge mass so the additive can get through insoluble substances. These may have formed a layer on top of sludge that could keep additive from getting anywhere. In most installations, agitation comes about naturally—by pumping of new oil into tank, convection currents from heating, action of oil returning from burners.

Larger doses than usually recommended may give faster results, but watch out—too much additive can disperse too much sludge, blocking strainers, etc.

Normal application. It takes a long time to accumulate sludge and it may take weeks to really get rid of it. But regular use of additive in purgative quantities eventually does the job. Then routine smaller doses should keep tank bottom clean unless you get stuck with some unusually bad fuel.

For most normal conditions, a quart of additive to 1000 gal of fuel oil should be enough, but exact quantities vary from one make to another.

Usual routine calls for pouring additive into tank before pumping in a fresh delivery. Resulting agitation distributes additive better. If possible, tank should be heated. This thins oil, promotes contact between oil and additive, makes it easier for additive to reach any accumulated sludge.

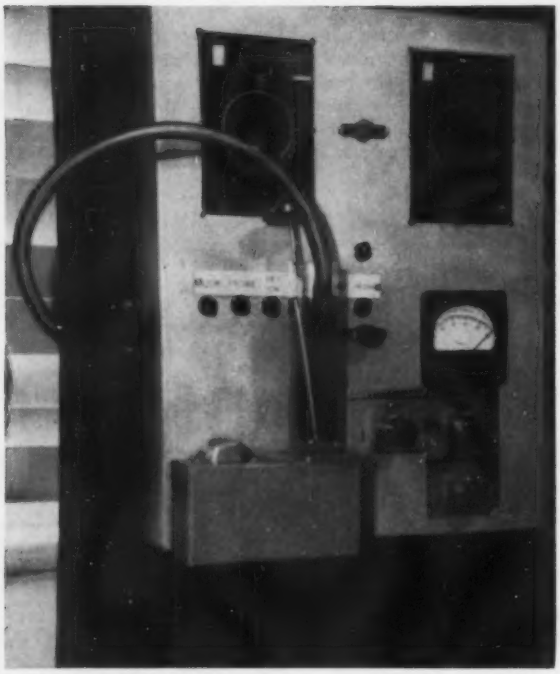
Use common sense—it's pointless to buy additive, then not apply it until trouble shows up. You're tempted to add treatment in large doses, hoping that will cure the headache quickly. Instead, you may only make things worse. Sensible scheme is to clear your fuel-oil system of sludge gradually and then use routine application of additive to keep it that way.

When you're using fuel oil treated with additive, you'll probably want to make some adjustments to burners and preheater setup. Air-fuel ratios often need changing and sometimes atomizing pressure may be reduced somewhat.

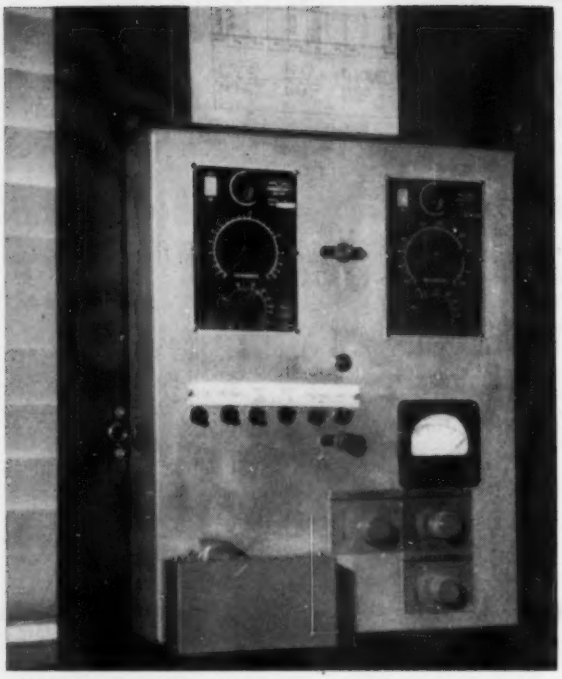
Don't expect miracles—a good additive, properly applied, cures many troubles caused by sludge formation. But no treatment can correct for a bad equipment setup or faulty operation—poor burner adjustment, wrong preheat temperature, tank temperature too low for good pumping, dirty heating surfaces, etc. No additive can do much of a job unless it's applied right. And even then it can't do anything about the "sticks and stones"—can't get rid of foreign materials, such as tank rust, lint or rags.

Buying additives can't be reduced to exact rules. As outlined above, some simple tests can be a help in preliminary checking. And, as in any kind of buying, you should give plenty of weight to the reputation of the manufacturer or supplier. Insights on this are often revealed by the way the product is sold. Beware the "high-pressure" approach and the fast-talking salesman who paints a rosy picture of what his additive does without being very specific about how it does the job. Representatives of reliable additive organizations know the technical ins and outs of their products, can advise on best procedures for application, recommended system changes for better results.

Remember, the final test of any fuel-oil additive is what it actually accomplishes in your plant under your operating conditions and with your fuel.



CONDUCTIVITY METERS, phototester mounted on aluminum radio chassis. Conversion chart is placed above for easy reading



TWO CONDUCTIVITY meters are connected into this switching circuit. Balancing tests are provided by precision resistors

Compact assembly speeds

Continued breakage of glassware and a hodgepodge of electrical cords gave us a lot of trouble with our conductivity meters and phototesters. A homemade mount solved the problem

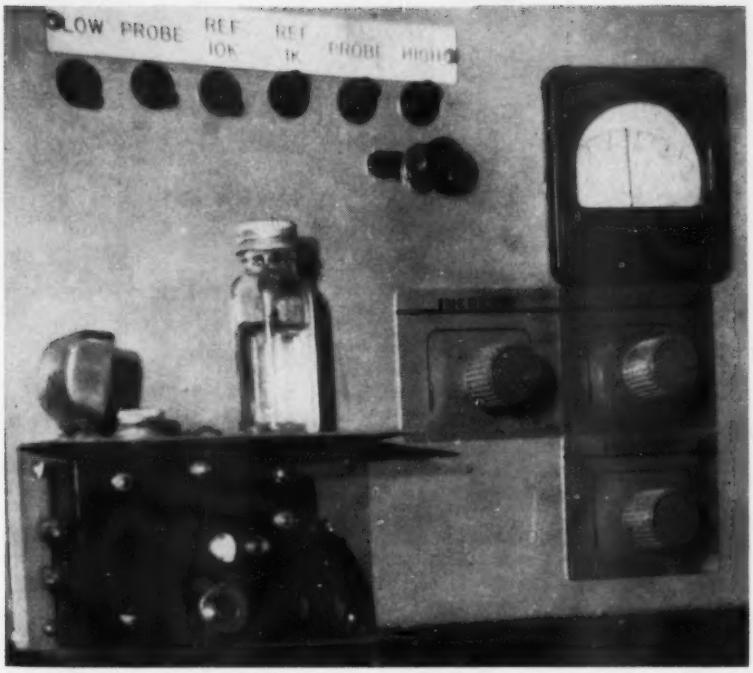
► CONDUCTIVITY METERS and phototesters for testing water are now commonplace in many power plants. The speed and accuracy these meters give make them worthwhile even with inexperienced personnel. Our plant has this equipment, but until recently we had our problems with it.

Glass breakage and a jumble of electrical cords caused the trouble. Our operators were under constant tension for fear of breakage during testing, making it necessary to start all over again. They decided that if the units were handily grouped and permanently connected, the problems would be solved.

Aluminum radio chassis, 13x17x4-inch dimensions, proved the ideal mount. The aluminum was easily worked. The mount is quite rigid and readily houses the two conductivity meters and the phototester, along with a rapid double-pole testing and switching network for the probes and a constant current transformer for supplying regulated voltage to the photo-cell light source. Photo above shows the testing unit as we mounted it. Chart for converting phototester meter readings to parts per million is placed above the panel.

Illustration at right shows the two conductivity meters connected into the switching circuit. We get accuracy within one percent on balancing tests by using precision resistors with this setup. And we can quickly interchange the probes between the two units by simply switching to give ranges 0-60, 20-400, 0-1200 and 400-8000 micromhos for water tests.

When we removed the phototester



PHOTOTESTER was removed from its original case and the meter was mounted on the testing panel along with additional balancing rheostats to give fine lamp control

feedwater tests

By L W FITZPATRICK
Chief Engineer, Department of Corrections
Jefferson City, Missouri

from its original case and installed it in the chassis, we put in additional balancing rheostats to give finer vernier control of the lamp illumination.

This photometric test unit provides rapid water analyses. A photoelectric cell measures light transmission through a water sample in the special bottle. Necessary reagents are added to the sample before testing. Readings on the phototester meter are interpreted on a simple chart to get results of analyses in parts per million. Photo above shows closeup of phototester unit.

Fast and simple in operation, the phototester tests for orthophosphate, total phosphate, sulfate, iron, silica, alumina and dissolved oxygen. For high concentration, a half or one-fourth sample is used and multiplied against the light meter reading.

Conductivity meters provide an electrical resistance measure. They are especially useful when chlorides in feedwater are low or subject to wide and sudden fluctuation. The greater the amount of dissolved solids in the water, the higher the electrical conductivity. This is always a direct measure of solids content because dissolved salts break up into positive and negative ions in water, permitting passage of electrical current through the solution.

So, with an increase in the number of ions present, resistance to current flow in the water is always reduced. Chemical tests for chlorides and sulfates give results for only these two substances. With the conductivity meter, ions of all kinds respond, making the meters more accurate for this type of measurement. The conductivity method does not measure sludge, which is not soluble in water, and organic matter, which cannot ionize.

Since all ions respond in the conductivity measurement, it is not possible to get any particular designation of the parts per million of salts. Between the meter reading and parts per million there is no exact relationship because it is dependent on the type of ions present in the particular water being tested. For this reason, the conductivity measurement is usually taken for a control reference point only.

For normal boiler waters, a multiplying factor of 0.75 may be used to convert conductivity readings to parts per million of dissolved solids. This is extremely accurate. We use a factor of 0.65 for condensates. Because of the lower conductivity effect of calcium and magnesium ions, the multiplying factor for most raw waters is about 0.8.

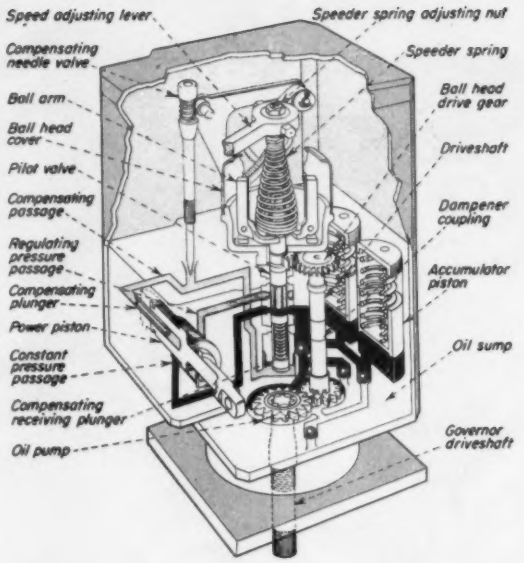
In establishing any factor for calculation purposes, you take into account the specific conductances of the particular salts present in the water. And the conductance of each one of these salts varies in a nonlinear fashion with change in concentration.

In other words, the conductivity of 20 ppm of sodium chloride will not be the same as that of 20 ppm of sodium sulfate.

Nor will the conductivity of 2000 ppm of sodium be a hundred times greater than that of 20 ppm of sodium chloride.

Solutions of low concentrations must be especially checked as they are easily contaminated when allowed to stand in plain glass bottle any length of time.

Does your diesel governor hunt, surge, stick, act sluggish? You may be able to make repairs without any specialized help. Follow these practical tips from C Morgan Jones, diesel engineer, who tells . . .



CUTAWAY of hydraulic governor shows oil passages and relation of hydraulic to mechanical parts. Note points of adjustment

How to recognize and cure

► THE MOST COMMON TYPES of diesel governors are mechanical and hydraulic. The mechanical type controls speed through spring-loaded flyballs. The hydraulic type uses much the same principle except that after engine speed has been measured or weighted by the flyballs, oil pressure transmits any required alteration in speed from flyballs through a connecting mechanism to the fuel control.

Here are (1) the things that most often go wrong with governors, and (2) what to do about them. We'll treat mechanical governors first.

Erratic speed changes, or sudden increases immediately following a governor overhaul, indicate that splines on governor shaft are stripped. It's a sure bet this is the trouble if you have grinding, metallic noise. Three causes are:

1. Incorrect alignment or uneven tightening of cap screws holding governor housing in position. Shaft becomes misaligned, and after running in this condition a few minutes there aren't any splines left to bother about.

2. Dirt, allowed to collect on splines during overhaul and not removed before reassembling. Result is the same, but it takes longer to strip splines. Washing parts in kerosene and coating splines with light grease provides protection. The grease also helps to cushion shock if splines are worn.

3. Worn shaft bearings.

Sudden engine-speed drop, followed by stopping. Remove governor cover and check high- and low-speed springs. If they are broken, fuel is cut off. Replace springs and reset engine. Don't use nicked, rusted or worn springs.

Hunting. Engine rpm changes without altering load. In some governors, lower parts are lubricated by oil, splashed from slinger on rotor shaft. If not adequately lubricated, heavy wear results, causing looseness of internal linkage parts and hunting. To cure, keep enough oil in the governor. But don't use too much, as you can drown the oil slinger, preventing it from throwing oil on the bearings.

On some engines, oil is delivered to governor through holes in camshaft pockets. Plugging causes oil starvation.

Dirt or binding of linkage may also cause hunting. In some fuel systems, overtightening of the injector's holding clamps jams the control rack, causes binding.

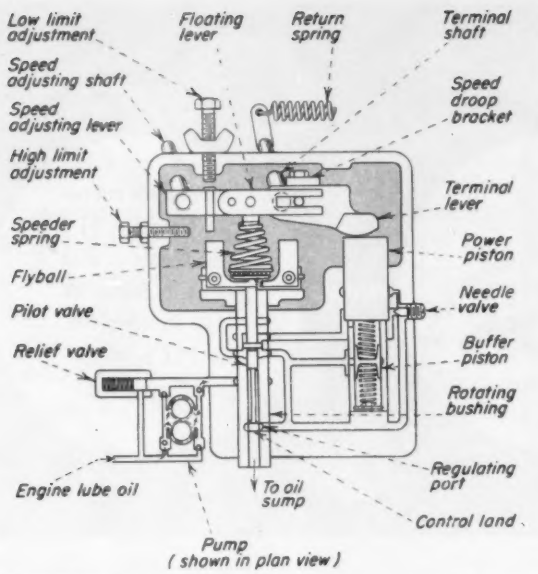
Engine stalls at idling speed. Alternate compression and stretching has weakened springs. Change them.

Speed too high. A matter of adjustment. If shims are used to increase pressure, remove, one at a time, until you attain correct speed. If there is a screw adjustment for spring pressure, turn to reduce or increase speed.

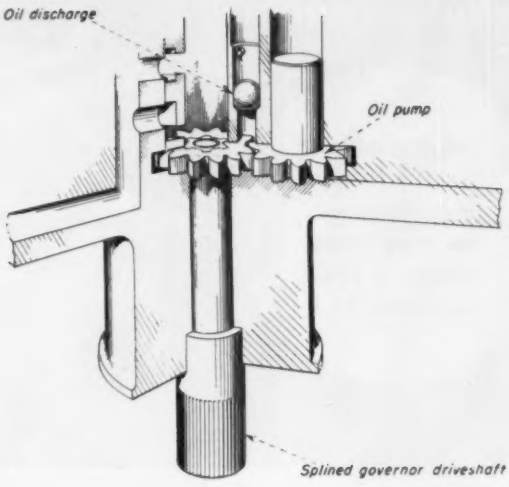
Flat spots. When throttle is altered, but checking with a tachometer shows no corresponding increase or decrease in speed, governor needs resetting. Be careful engine doesn't overspeed if you make adjustment while it's running.

Rolling variations, noticeable when engine is idling, are caused by buffer spring screw. It kills oscillation of lever that imparts governor motion to throttle lever. Tighten just enough to stop roll. In some governors, you cannot stop the engine if this screw is overtightened.

Broken or loose flyballs or flyarms. Some older engines may run away if flyballs or flyarms break. Broken bits may crash through governor housing. Stop the engine and renew broken parts. Check that new parts are same size and weight as the old. Pins holding the arms in position may also fail. Whenever you dismantle governor, make sure



ISOCHRONOUS hydraulic governor permits maintaining exact constant-speed control of a diesel engine without hunting



OIL-PUMP CLEARANCE is important in governor operation. Check it without dismantling by turning drive shaft by hand

diesel governor troubles

there are no marks caused by weights striking the housing.

Sluggishness may be caused by scoring of thrust sleeve, when fitted. If sleeve is scored after a short period of use, upper shaft bearing may be worn.

Speed droop. This is a percentage: no-load speed minus full-load speed, multiplied by 100 and divided by no-load speed. A simple screw adjustment controls it on most governors.

Another cause of speed variation is stripped or worn drive gears. If these gears are heavily worn, suspect improper installation. Gear train must drive governor at speed higher than crankshaft, but in direct proportion to it. Irregular governor speed through damaged gearing is corrected only by replacing gears.

In hydraulic governors, dirt is the biggest source of trouble, but here are a few other causes and their remedies.

Surging and hunting. Check governor oil level; fill if necessary. If oil needs frequent topping, inspect seal between shaft and casing. Renew if leaking. Make sure other gaskets are also tight. Clean flanges before installing new gaskets.

Overshooting results from stickiness. When load increases, engine speed drops and flyarms come closer together, acting to deliver more oil through linkage to power piston. If this piston is sticky, a big oil pressure may build up before it breaks away. When this happens, it overshoots the mark. Too much fuel enters the cylinders, engine accelerates, and governor goes into action to slow it down. Piston is just as sticky, and when it breaks away again, speed drops too low. Clean governor.

Drain out all old oil. Refill with cleaning fluid—light diesel fuel oil, carbon tetrachloride, etc. Run engine with compensating valve in wide-open position. Let engine surge. The bigger the surges, the better. Drain solvent and replace with recommended oil, but first inspect for any remaining sludge. Soak hard-to-shift gummy deposits with carbon tetrachloride.

Sticky governor. If governor is slow to respond to calls for power, check for binding of injector mechanism first, especially any racks or other linkage. Dirt and paint are often the cause.

Pump troubles. If end clearance of pump is too great, pressure and capacity are reduced. Result is sluggish operation. If clearance is too small, heavy wear results, indicated by scoring of pump base or cover. To test for clearance without dismantling, lift governor from base, turn drive shaft by hand. If hard to move, clearance is insufficient; if shaft moves too freely, there is too much clearance.

Engine fails to reach rated speed under load. If injection and other units are working OK, try adjusting power-piston stop. If engine "lugs" and pours out black smoke under load, no amount of playing around with the governor will do any good. Engine is overloaded.

If the diesel hunts or surges for more than 90 seconds, and governor fails to establish control, stabilize speed by adjusting compensating valve incorporated in power-piston cylinder. A one-eighth turn to left or right does it.

Chattering. Dampener coupling on ball-arm drive shaft may fail to absorb engine impulses, while sound appears to come from the power piston. Renew couplings.

Oil foaming may be caused by overfilling governor. Foaming oil finds its way through shaft seal and weak gaskets. It also deposits sludge and leads to heavy wear of governor parts. Fill governor to correct level only.

What is regain?

Weight of material is 111.6 lb when in equilibrium with air having relative humidity of 80%, temperature, 70 F

minus

Weight of the material when it is bone dry: 100 lb

equals

Moisture in material from air: 11.6 lb. Regain is then 11.6 lb, divided by 100 lb, times 100, or 11.6% for conditions given

Rh control is important. 'Regain'

Absorbed moisture of material is often highly critical during certain stages of processing. And relative humidity is the primary weapon to control it. The same material may need different conditions at different stages in the usual manufacturing cycle

► COMFORT IS NOT ALWAYS the primary purpose of an air-conditioning system. Often it serves to condition or dry manufacturing materials, acting as an absorbed moisture controller. Conditioning refers to an increase in absorbed moisture in a material, drying to a decrease. Absorbed moisture, or "regain," as it is sometimes termed, must frequently be held within narrow limits for a manufacturing process to be successful.

Regain, as defined in the chart above, is the ratio of weight of absorbed moisture in a material to weight of same material in a completely dry state. This ratio is expressed as a percent. Materials involved are those that readily absorb and retain moisture from air (hygroscopic materials). They are generally of vegetable or animal origin. Sometimes, however, minerals have hygroscopic properties.

We have spoken in terms of *absorbed* moisture in materials. Why not just moisture content? The answer is that moisture content of a material is made up of both free and hygroscopic moisture. Free moisture results from submersion or wetting. Hygroscopic moisture is that absorbed from the atmosphere and depends on atmospheric conditions. We are concerned here with regain which is a measure of only the hygroscopic type.

Regain varies with relative humidity (rh) and to a smaller extent with temperature. Say we have air at 70 F, 70% rh. If temperature is increased to 80 F and water vapor is added so rh is still 70%, the effect of temperature rise is about the same as a *decrease* of one percent in rh. In other words, it is about the same as if the air were at 70 F, 69% rh.

Materials vary widely in regain from one another for the same humidity and temperature conditions. Also, rates of absorbing moisture from air or giving it up to air vary with the material. When a material in a given atmosphere neither absorbs nor gives up moisture, it is said to be in equilibrium with the surrounding air.

Equilibrium is obtained when the vapor pressure of the absorbed moisture in a material is equal to the vapor pressure in the air. And vapor pressure in air is a measure of its rh. Regain data, given in various handbooks, are for the equilibrium condition of the material at different rh and sometimes at different temperatures.

Here are a few percent regain figures—for more detailed information, see handbooks. These data came from Marks' *Handbook*. Air temperature is 75 F.

Percent relative humidity	*Wool, worsted*	*American cotton*
10	4.95	2.50
30	9.30	4.60
50	12.60	6.05
70	16.55	8.55
90	23.95	14.10

When a material absorbs moisture

Adding moisture

Material as received has absorbed moisture of 9.1 lb per 100 lb of dry weight, corresponding to equilibrium with 50% relative-humidity air at temperature of 70 F

Absorbed moisture desired for processing is 14.5 lb per 100 lb dry material. Then 70-F air could be supplied at 80% relative humidity to give the regain that is wanted in this material

Removing moisture

One inch hardwood has regain of 31 to 40%. Wet process may be used to cut down drying time. Steam spray in kiln permits high humidities when they are desired. Typical schedule is shown at the right

Day	Temp, F	Rh
1	120	95
2	126	100
3	130	100
4	133	95
5	137	89
6	140	82
7	143	74
8	145	67
9	147	62
10	150	57
11	152	53
12	154	48
13	156	45
14	158	42
15	160	40

needs may make this doubly so

from air, dry-bulb temperature of the air goes up. This is the result of latent heat being released as sensible heat. On the same basis, dry-bulb temperature of air goes down when material gives up moisture to the air (here latent heat must be supplied from surrounding air). In both cases, however, wet-bulb temperature remains the same. Action takes place on a constant wet-bulb temperature line.

Moisture is often expressed as a percentage based on the wet weight of the material. To get regain ratio based on dry weight, divide percent moisture on wet basis by 100 minus this percent. Then multiply this ratio by 100 to get percent regain.

Relative humidities and temperatures used for processing depend on the materials being processed. In general, humidities over 50% increase softness and pliability of material and decrease static electricity and atmospheric dust. But lower rh are sometimes needed for drying. Often a continuous process is used. Here the material to be conditioned or dried is sent through a long compartment where it is subjected to various conditions of rh and temperature.

Drying a material too rapidly may injure it in some way. To prevent this, moist air drying is used. Rh start out high and gradually decrease following a definite temperature and rh schedule.

Simple conditioning example above proposes supplying air at exact rh and temperature of desired equilibrium. In other words, 14.5% regain corresponds to equilibrium at 70 F, 80% rh. At the start of the conditioning process, moisture is being absorbed by the material. As stated before, dry-bulb temperature rises and wet-bulb remains the same—this also means rh goes down. When air leaving the process area has the same conditions as that entering, then conditioning is complete. Let's take a look at some actual figures for this example.

Suppose we take readings of air leaving the processing area shortly after start of conditioning. We find the wet-bulb temperature is 66 F, same as entering condition. But the dry-bulb temperature has gone up to 74 F. So rh of air leaving is 67%. Checking the humidity chart, we see that the material is absorbing about 25 grains of moisture per pound of dry air. When we find that exit dry-bulb temperature is 70 F, conditioning is complete.

Wet-process drying is often used for hardwood. This reduces the drying period considerably. Steam spray in kiln permits high humidities when desired.

Lower rh of the dry process cause outer surfaces of lumber to dry rapidly, with the result that it becomes case-hardened. This makes it difficult to dry the inner portion of the lumber. Also, difference in moisture between surface and interior causes internal stresses. And checking may result.

Typical drying schedule for hardwood, taken from Marks' *Handbook*, is shown above. Resulting regain is about 5 to 10%.

Rh control is important throughout the manufacture of viscose rayon. In the drying and conditioning stage, excess moisture is removed and the final regain fixed. Enormous amounts of water are removed. Some of this water is absorbed moisture, more of it is free moisture. Rapid drying calls for maximum volume and velocity of air short of entangling the yarn.

Conveyor dryer uses propeller fans for vigorous circulation and separately controlled heaters. Separate control of both temperature and humidity is essential in all stages. Upper temperature limits depend on particular product. Temperature of material at wet end corresponds to wet-bulb temperature of air. It approaches dry-bulb temperature of air at dry end.

Final regain desired is about 10 to 11%. This corresponds to rh of about 60%. To prevent regain from flashing off the hot product, a final cooling, conditioning stage must be added to dryer.

AUTHOR CHECKS rewound motor. Now motor has tough insulating finish, lacking air pockets, capable of withstanding heavy mechanical stress without grounding-out

Meet the epoxy resins!

The epoxies, as a coating material, offer top protection against weather, corrosion and wear. They have been making a walloping good name for themselves. This is what you'd expect when, for example, a 5-mil paint job on plant gear requires but three passes of a spray gun to give results that stack well against more elaborate and time-

Now a chemical tank car can be lined in a short time with a surface finish hard to lick. And one of the potential new uses is in chemical and petrolum tankage and pipelines . . . not just as a protective coating but as a primary structure. Plastic pipes present another field to conquer.

Though plastics have been used as piping materials, nobody has yet been able to develop a plastic pipe that withstands both high pressures and temperatures, yet remains impervious to corrosive materials.

Moisture, chemical atmospheres, rough operation are no longer bugaboos as...

Epoxy resins make bid for motor insulation

By L J REJDA, *Field Engineer, Larsen-Hogue Electric Co, Los Angeles, Calif.*

► FOR SOME TEN YEARS, makers of chemical magic have been bubbling over with praise for a new group of synthetic materials called epoxies, sometimes labeled as ethoxylene resins. Through this decade, the epoxies have met and licked many problems in the fields of adhesion and coatings—from giving birth to a new breed of glues to serving as a prime ingredient in making the home automatic washers stand up under the daily onslaught of high-powered detergents.

Electrical insulation. Moving close to the power field the epoxies, because of their high dielectric properties along with other necessary characteristics, have worked their way in as electrical insulators. They have found many spots to prove their stuff in the electronics field. Today, they can be found in transistors, selenium rectifiers, and capacitors.

When reinforced with fibrous glass for added strength, the epoxies have been used in the manufacture of printed circuits. Of more recent vintage is the use of *Orlon* fiber as the reinforcing material. Now we find epoxies making overtures right in the heart of the power domain—the electric motor.

Why. We followed the epoxy trail in our company simply because we ran into motor troubles that couldn't be licked with the present insulations. Here's a rundown on some of the tough ones we met:

A moderate-sized water utility had a 125-hp motor driving a well pump, which failed for the third time in five years. A new motor on a processing machine in a citrus plant failed after two weeks. A large vertical totally enclosed motor, driving an agitator above an acid tank, gave a large chemical company an average life of 18 months. Field coils of a large synchronous motor in a rubber plant had to be reworked and reinsulated about every nine months. Average life of some dual-stator watercooled motors on milling machines in the aircraft industry was about one month. Some 2-hp totally enclosed motors operating cutters in the rubber industry lasted three to nine months.

The search. All these motors were used in heavy-duty

applications where standard insulating methods and materials failed to give satisfactory service. Almost every industry has some motor applications that are a headache, costing millions in downtime, lost production and frequent repair bills.

We looked into the entire field of motor insulation checking carefully to see if recent technical advances of the chemical industry might provide a solution. Included in this study was a review of the many new synthetic resins as well as a critical analysis of insulation techniques.

After reviewing countless new and old resins, we formulated a new material based on the epoxy resins. There are several suppliers of this resin; we chose Shell Chemical Corp, producer of *Epon*. The mechanical, electrical and chemical properties of epoxy resins, coupled with their superior adhesion to copper and iron, make them well-suited for motor insulation.

Resin properties. When the epoxy resins were first introduced, many of the properties, now proven, were not obtained in the end product. This was because they were new and had to be crosslinked or catalyzed to be cured. In addition, the basic epoxy resins are highly temperature-sensitive. Some are hard solids at room temperatures; others are very thick liquids, like molasses in January; still others are as fluid as water. Viscosity and flow characteristics of these resins change markedly with even small temperature changes.

We also reviewed the various insulating techniques, materials and methods used in motor winding: (1) Stators (or rotors in wound-rotor motors) to be wound are cleaned and any sharp slot burrs are filed off. (2) A slot cell material, usually dry paper, is inserted in stator slots. (3) Coils are wound into the stator with dry-paper fillers taking up any unfilled space. (4) Top sticks are driven into each slot to snug up the coils, hold them in place. (5) Groups of coils are connected and the wound stator is ready for impregnation. (6) Wound stator is immersed in a tank of varnish, usually a phenolic-based varnish, having a solids content that may vary from 30 to 50%.

How trouble starts. With conventional insulating techniques and materials, the theoretical but erroneous hope is that the varnish will flow into and completely saturate each cell. Actually, the extent and uniformity of the applied coating is questionable. Slot paper and coils are wedged tightly against the stator iron, resulting in partly or entirely dry areas, and incompletely saturated slot paper. Pressure points occur in all cells, so the very points that require the best coating receive almost none. Even vacuum and pressure impregnation cannot remedy this condition.

Another vain hope is for better heat transfer with standard varnishes. The simple fact remains that literally thousands of various-size air pockets are formed in the slot areas by wire crossovers, pressure points, uneven iron laminations, bent and displaced strands of wire. These lead to hot spots.

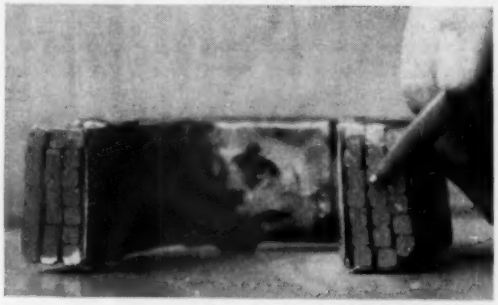
In everyday practice it is impossible to fill the air pockets. Even if it were possible to drive the varnish in, you would still end up with a void space of 50 to 70%, since that much solvent or volatile matter is driven off in curing. Experiments show that a thick, cured section is in effect a spongelike material with pin holes and capillaries extending throughout.

Experience also shows that when impregnating a wound stator, the larger exposed stator cavities are quite easily filled during immersion in varnish. But, when the stator is drained, most of the varnish (or any liquid material) runs out and leaves only a thin questionable coat.

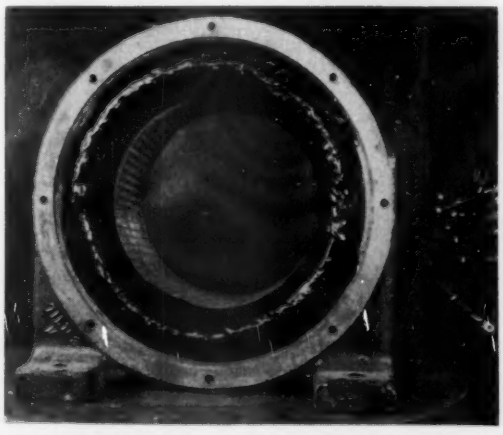
Reasons for motor failures under tough operating conditions were apparent. Under high humidity, temperature changes between a running and an idle motor are such as to suck moisture into the stator slots. Unsaturated portions of the cell paper then become wet, leading to destruction of

These features help make epoxies well-fitted for motor use

Epoxy materials for this job flow freely . . .



develop air-pocket-free fill between turns . . .



with tough finish to meet tough service

its dielectric properties and later failure of winding by grounding.

On the basis of thousands of motor repairs, and a careful analysis of the various causes of motor failure, we developed a new technique. Hinging on an epoxy-resin-insulating material, *Epoxylite* (America Insulating Materials Co) the new method promises to eliminate most of the difficulties previously met.

How we insulate. Our new process for winding and insulating motors for severe applications consists of the following essential steps: (1) Stator iron is cleaned, usually by sandblasting, and all sharp burrs filed away. (2) Bare stator iron is immersed in an *Epoxylite* insulating formulation (based on Shell's *Epon* 1007 resin) and cured. This step is repeated until about a 4 to 6 mil coating is obtained over the entire stator's iron and slot sections. This gives positive cell insulation with a virtually indestructible material right on the bare iron before motor is wound. Regardless of pressure points that occur in motor winding, cell insulation is positive and grounding of the winding is improbable. (3) Stator is wound according to accepted practice. (4) To overcome sealing and filling problems involved in final motor insulation we used an epoxy-resin-based formulation, which has less than 2% shrinkage in filled formulations when cured.

To solve the drainoff problem encountered with varnishes, a thixotropic *Epoxylite* paste was developed. With this material it is possible to construct a mold that becomes a part of the insulated motor. After it is formed, a catalyzed liquid *Epoxylite* sealer is poured into the mold, which allows it to flow into the slots and fill each cell section. The result: a practically indestructible motor with the entire winding potted and insulated.

Field applications. Let's look at a few on-the-job applications. A 125-hp vertical motor in a water company failed for the third time in five years. Failures were caused by a combination of frequent starting and excessive moisture.

This motor had long coil extensions with two tie-rings on either end. After rewinding, the coils are snug in their slots and coil extensions are tied securely to end rings. However, starting causes a mechanical stress on windings, particularly on coil extensions, tending to stretch the twine. Each succeeding start attempts to stretch the twine further, permitting coil movement. At the same time, standard insulations shrink and become brittle with age.

The second point is moisture. During heavy rains, water either leaked in or condensed on the upper end bell of this motor and eventually a drop or two would fall on the winding. With insulation deteriorated by coil movement, even the slightest amount of moisture means trouble.

Last time this motor had to be repaired, it was rewound according to the new techniques. Because the coils are completely encased in epoxy-resin-based insulation, tie rings are not necessary. Epoxy material has good mechanical strength and adhesion, yet is resilient enough to take the starting surges without fracture. The insulation also provides a positive, capillary-free seal against moisture, chemicals or other foreign matter. After about a year's operation, no change can be detected in the insulating material.

The National Tapered Wing of Los Angeles had many failures of their 60-hp dual-stator watercooled motors. Their chief electrician, Don Derby, figured that periodic overloads, plus frequent flooding of the winding because of coolant leakage, probably accounted for the failures.

These motors have now operated for many months without failure, even though completely waterlogged at times. In this case, silicone-insulated wire was used for high-temperature turn-to-turn insulation, and the windings bound and sealed with the epoxy formulation we find so successful.

Motors to drive cutters at the Goodyear Tire and Rubber plant in Los Angeles take a severe beating. Subject to almost constant water spray, these motors, although totally enclosed, frequently fill with water. Holes were drilled in the frames to allow the water to escape, but still winding failures continued at a high rate. Motor life varied from a few hours to several months. The first of these motors was rewound by the *Epoxylite* process approximately one year ago. Present outlook is for long continued motor life despite the severity of application.

Growing pains. This material and technique have been in the field-trial stage for well over a year, and results so far are highly promising. Toughest test we faced was a joint venture of the Coker Construction Co and Peter Kiewit Sons' Co, subcontractors on the Tecolote Tunnel near Santa Barbara, Calif. This is a tough tunneling job where a man works in water up to his chin. And motors specially processed for this project with the epoxy material are holding up.

New developments. Most recent development is the manufacture and winding of form coils for large motors. Here is how we do it.

A coil is wound, ends are tied, and coil spread to proper form. At this stage, the wire has only its normal strand insulation, whether it be cotton, glass or silicone. Choice of insulation depends on temperature-rise requirements.

A slot section is cut out of a loose-weave glass cloth This slot or cell material is given a thick coating of a precatalyzed mica-filled epoxy-resin formulation. While the coating is still viscous, the cell section is wrapped around the coil. A single layer of glass tape is wound around the cell section to hold it in place. Another coat of plastic is applied over the tape, and the entire unit is then placed in a hot press where four tons of pressure squeeze out excess liquid. Surplus is wiped off before curing is completed—about five minutes—and the result is an indestructible cell section with a positive shape and dimension.

Essentially, the cell section is a strong mica, glass, epoxy-resin laminate, positively and permanently bonded to the turns of copper wire in the coil. Fill is 100%, thereby providing excellent heat transfer. By this process we have eliminated the loosely wound tapes that create dead air pockets and keep heat in the coil. Chemical, electrical and mechanical properties obtained from this material yield a superior molded cell section.

In the winding of form coils in large stators, another general though questionable practice is the waxing or lubrication of cell sections so they slide into tight-fitting stator slots. With a wax-coated cell section in the slot it is impossible for the final varnish impregnation of the wound stator to do its job of providing a bond between coil and iron. Operating temperatures simply melt the wax film.

With the new process, cell sections and slots are lubricated with a coating of a precatalyzed epoxy-resin formulation. Not only does it provide adequate lubrication, but it also solidifies to give complete fill and an excellent bond to stator iron. Finished product is a motor where copper, insulation, and stator core form a solid, one-piece unit, almost indestructible, without hot spots, and unaffected by moisture or chemical attack.

Versatility of the epoxy materials opens unlimited fields of use. They have sealed leaky transformer tanks, provided a seal and mechanical strength for copper buses extending through bushings, mended broken transformer bushings, bonded slip-ring assemblies to rotor shafts, sealed cable splices, acted as a protective coating over bus bars—all with excellent results. You'll be hearing more about them.

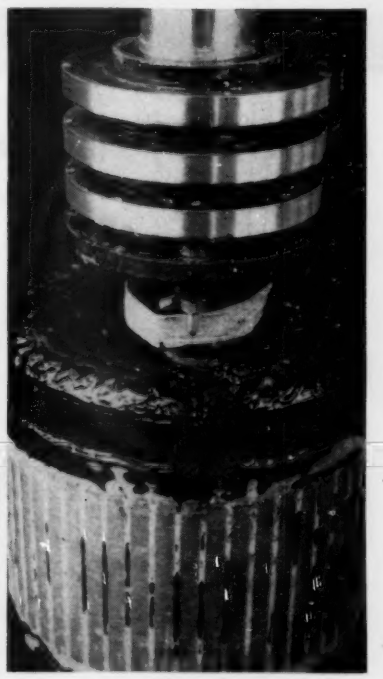
1 Rotor, dipped and cured before winding, is now ready for sealing, filling

2 Masking-tape mold is next step. Wrap tape snugly around rotor's end slots

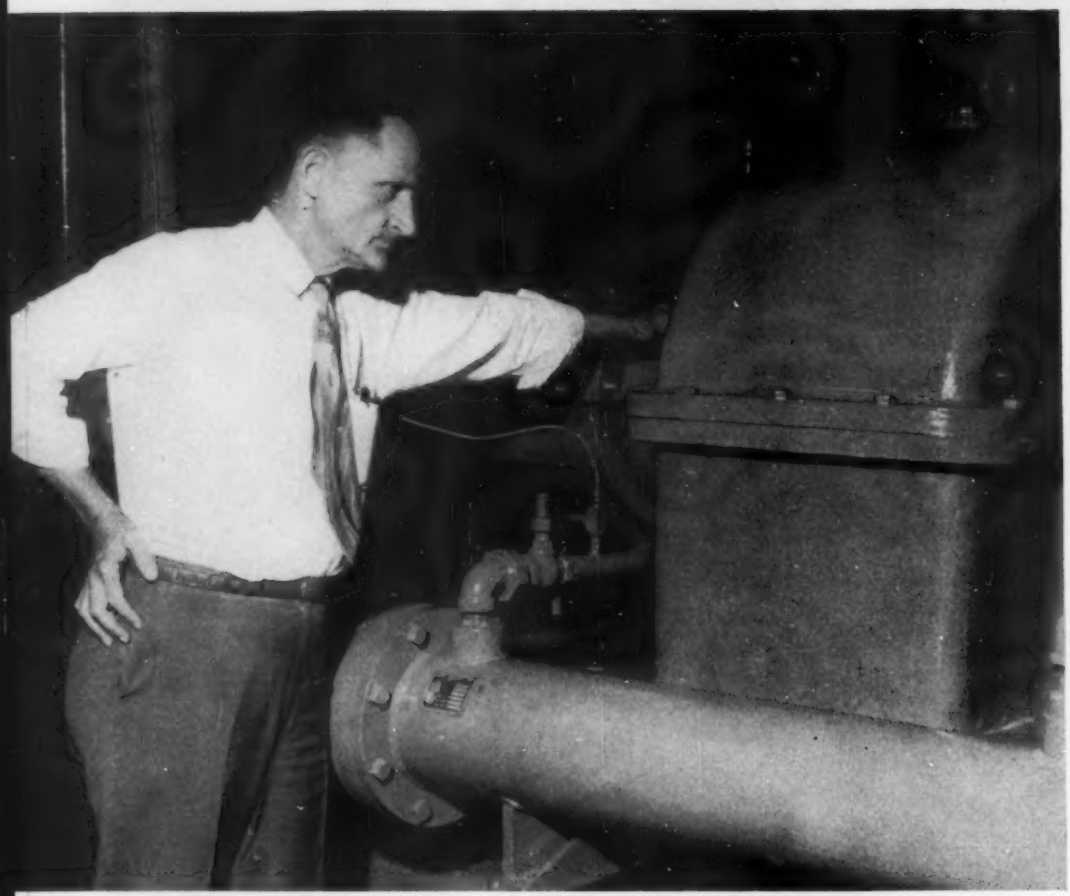
3 Temporary tape-mold sealed to rotor iron with an epoxy resin-based paste

Here are the 5 simple steps we follow when applying the epoxy materials to a wound-rotor during a rewind. We're getting top results

4 After both the outer mold and similar inner mold are complete, pour sealer



5 Rotor completely sealed and filled. Excess material can be machined off

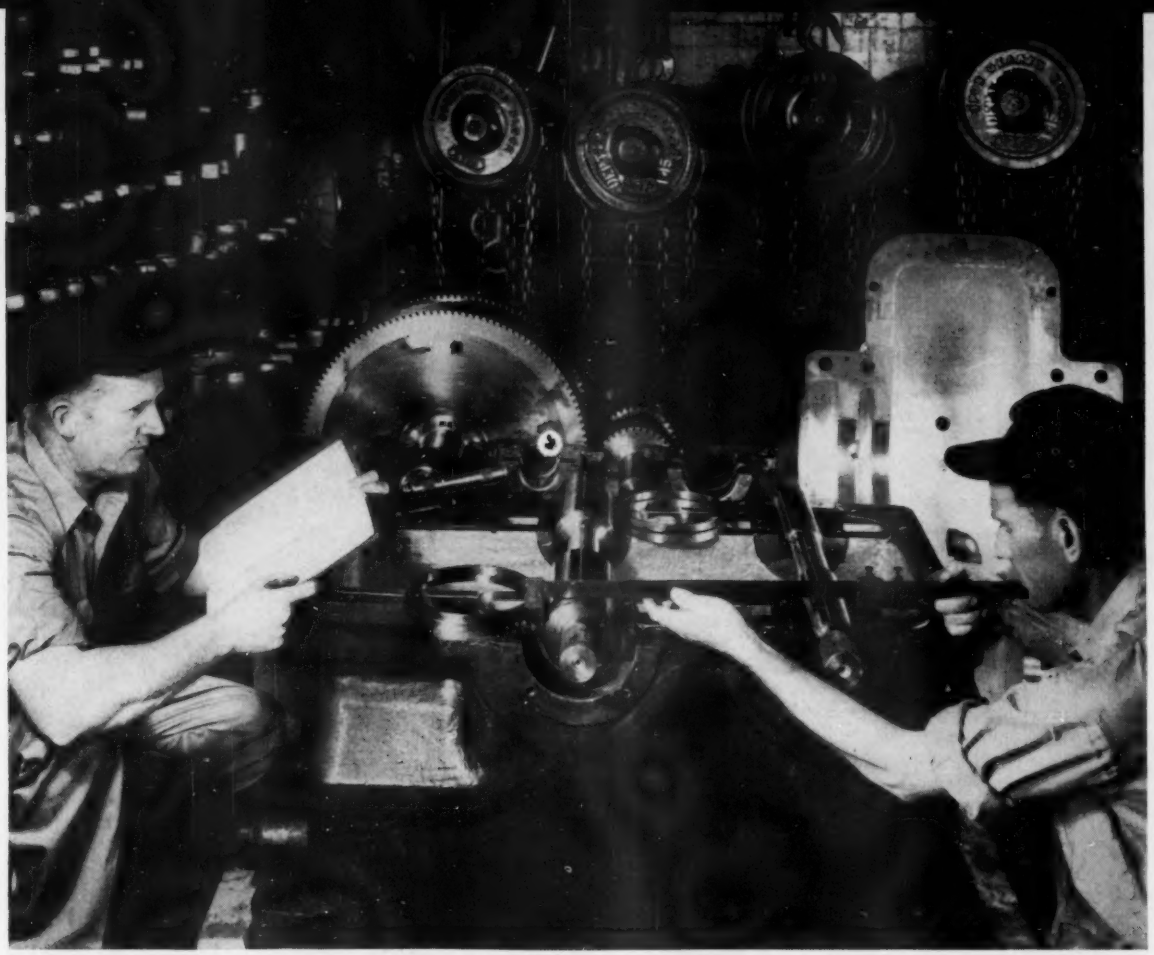


Sam O'Neill, maintenance supervisor, tells...

'How we cut breakdowns on reduction gears with this 3-part program'

► BACK IN 1950, breakdowns of large reduction gears reached a point where we had to do something at the Kingsport, Tenn. plant of Tennessee Eastman Co. As supervisor of Power and Services Maintenance at this plant, let me outline what happened.

From May 1948 to November 1950 our company had lost eight sets of 550-hp gears on one steam-turbine-driven induced-draft fan. And failures occurred on other geared units. There were 15 sets of reduction gears in the main steam plant alone, and some kind of trouble almost daily. As many plant facilities depend on boiler operation, a planned shutdown schedule was desirable. But frequent breakdowns made this impossible. We couldn't solve the problem by merely making urgent repairs. So we decided to (1) broaden training of personnel (2) eliminate vibration (3) clean up lubrication:



CHECKING GEARS against specifications is a precision operation. Mechanics often work to tolerances of a thousandth of an inch

1 Broaden and intensify training of personnel

Because our program was to deal with both the repair and the day-to-day care of reduction gears, giving maintenance personnel the proper training became highly important.

Most of our Kingsport plant has been built in the last 20 years, and it now requires 7700 men and women to run it. As in many another fast-growing business, the watchword has been "production." Those charged with responsibility for equipment upkeep had gradually become known as the "repair crew," rather than as maintenance personnel.

To get out of the rut of forever patching up breakdowns, we had to improve the skill of this repair crew, gradually raising their sights to the planned-maintenance level. We decided to (1) write maintenance manuals (2) assign machinists to maintenance groups (3) bring in manufacturers' service men for help and consultation.

Maintenance manuals became the first item in our program. They were written and illustrated in an easy-to-follow step-by-step style designed to give each mechanic an approved method of disassembly and reassembly on all major equipment. We now require each mechanic to study and use these manuals during his training program.

Assigning machinists. The part of the program that paid the greatest dividends in the shortest time, however, was having journeyman machinists work with our maintenance men. We transferred enough journeymen from the central shops into the maintenance group so at least one machinist could be assigned to every major job.

The machinists were instructed to make every repair a precision job, and to help train the assigned mechanics to do precision work. Every job set up cold got a careful "hot check." Where temperature changes caused growth of metals, the machinists made corrections to the thousandth of an inch. Maintenance mechanics, working with the machinists, quickly grasped the importance of working to closer tolerances.

Service men help. As another instruction source, we called in the equipment manufacturers' service men. While the program lasted, a factory service man, a machinist and our own mechanics worked on each gear job.

We told the service men frankly that we needed their help in developing the know-how and techniques for maintaining their company's gears. Each one responded wholeheartedly as soon as he realized we really needed his assistance.

Some of them even used lunch time and smoking periods to explain how certain jobs were done. Both service men and mechanics developed a very keen interest in the work.

The written instructions furnished by equipment manufacturers and the many useful ideas of the service men were very helpful. We incorporated as much of this information as possible into our maintenance manuals for each major type of equipment. These manuals also show clearances, tolerances and parts lists. In the case of gears, they explain the preferred method to be used for attaining proper alignment of entire unit.

(Continued on page 128)

2 Eliminate causes of inherent vibration

A study had indicated that vibration was one of the contributing causes of our gear failures. But our maintenance men knew little about this subject. So we formed a technical group to study vibration troubles and, meanwhile, started to eliminate some of the known causes. Chief among these was vibration of the fan-room floors.

To give you a better picture of the scope of the vibration problem, here is a thumbnail sketch of the powerhouse fan arrangement: The fans supplying air for the 12 steam boilers in the building are mounted on a mezzanine section of floor in the main boiler room, about on a level with the top of the boilers.

There are 12 induced-draft fans, all geared, and six forced-draft fans. They operate at 800, 1000 and 1600 rpm. Speed of the induced-draft units varies automatically with the boiler needs.

Floor of this room is 5-in.-thick reinforced concrete, 18 ft wide, supported by 16- and 24-in. I beams, and running the full length of the powerhouse. At the time of the study, no partition separated fan room from boiler room.

To eliminate vibration of the floor, we first boarded up the supporting steel directly beneath some of the fans. Then we poured the spaces between the beams full of concrete. This stiffened up the foundation floor and reduced vibration considerably.

On five of the induced-draft fans, the gears and turbine are mounted on top of rectangular steel bases made of 8-in. channel iron and ½-in. plate. The steel bases also served as reservoirs for lubricating oil. A ½x6x36-in. steel strap was welded from one side wall to the other and across the center of each reservoir.

We cleaned out all oil and sediment, then filled the bases with concrete, pouring through windows cut in the top plate of the reservoirs. This made further inroads on the vibration problem and, incidentally, showed up the need for the third part of our over-all program—cleaning up the lubrication (see facing page).

VIBRATION-DISPLACEMENT indicator gives simple check on operation smoothness

New reservoirs were made from 6-ft lengths of 12-in. pipe. To allow for cooling, we brazed 24 ft of 1-in. copper tubing inside the pipe. This arrangement eliminated the original undersize oil coolers.

The technical study group discovered another factor that contributed to the troubles—torque vibration between the turbines and gears. We eliminated this cause of vibration by replacing a non-lubricated laminated-disk-type coupling with a grid-member type, which acted as a dashpot to absorb shock set up in the existing coupling.

Vibration displacement. During their study the technical group had used instruments not normally available to the maintenance man. We decided that mechanics should be able to make periodic checks of vibration on the geared units. So we purchased a small hand instrument, known as a vibration-displacement indicator. This instrument, which any mechanic can easily use, has proven very helpful, particularly for checking the increase in vibration of operating units.

The indicator has a transparent bar scale, about 3½ in. long, graduated from 0 to 15 mils. When the contactor is placed on a vibrating unit, a beam of light oscillates on the graduated scale. Total length shown on the scale is read as the degree of vibration.

3 Clean up the lubricating oil

When the old oil reservoirs in the gear and turbine bases were cleaned up to permit filling with concrete, we found heavy deposits of abrasive material in the bottom. Tests showed that most of this material was flyash, with varying percentages of steel particles mixed in.

We tried three ways to keep the lubricating oils clean: (1) frequent changes using new oil (2) centrifuging (3) filtration. The first method was a boon to the oil dealers, but too expensive. We discarded the second because the only centrifuge available was an old worn-out unit that could not be maintained in good condition. The third method, using a filter, fitted our needs.

The electrical department had a portable filter press for transformer oil. Experiments with this unit indicated it would remove the solids and most of the water from the lubricating oil. But it required a more porous paper for our higher viscosity oil than for the transformer oil. This borrowed filter proved so satisfactory that the company purchased a similar unit for lubricating-oil maintenance.

We put pipe nipples in each end of the oil reservoirs, valved so oil could be filtered while the unit was in operation. Placing nipples at lowest points in opposite ends of the reservoirs set up a washing action during filtering.

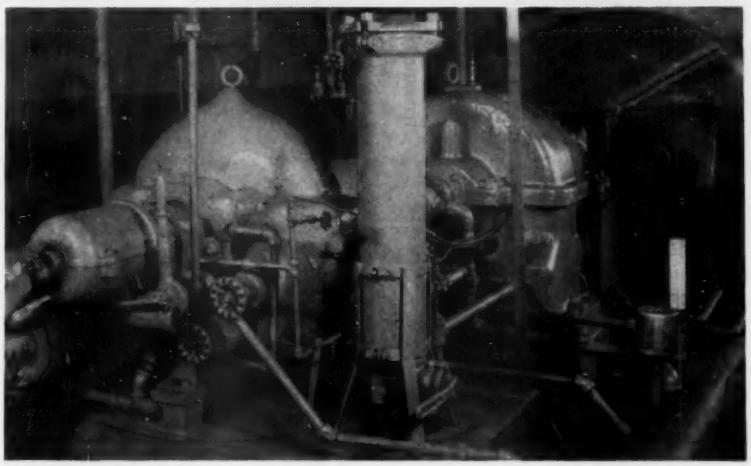
The filter is a 15-gpm 15-plate motor-driven unit without drier or fuller's earth attachments, top photo. We do not use clay tanks and cartridges in the process because certain valuable inhibitors may be removed from the oils.

Flyash excluded. Investigating the oil-reservoir sediment problem showed that flyash from the boilers got into the oil through leaks inherent in the equipment design. The open vents and the lance-type oil-level gage stick openings were the worst offenders. The 1-in. pipe vents coming out of the reservoirs had 180-deg bends at the top of the riser pipes, with one end of the bend open to atmosphere. Installing 1-in. air-intake filters on the vent lines eliminated this source of trouble. Also, we put oil-proof flat gaskets on each lance gage.

Filters in the oil-pump discharge line permitted filtering oil continuously in the geared units. Pressure gages on each side of the filters showed when they should be cleaned; bypasses allowed cleaning with units in service.

Bottom photo shows the air filter on the horizontal oil reservoir. Vertical cylinder is the oil filter. The reservoirs can be cut loose and moved about for convenience in cleaning.

PORTABLE OIL FILTER attaches to reservoir, removes solids, water from lube oil



AIR-VENT FILTER keeps flyash out; permanent oil filter screens pump discharge

Every two weeks maintenance personnel take 5-oz. oil samples from the bottom of the reservoirs to determine the amount of water in the oil. If there is too much water, they make provisions to drain it off. If the samples show emulsification or other undesirable conditions, we take precautions to protect the equipment while making plans to take the unit out of service. Water in the oil also points up the need for a close check of the sealing glands on the steam turbine at next outage.

Partition added. As mentioned earlier, there was no partition between boiler room and fan room at the time of the initial study. Largely because of high ambient temperature, we were using a 600-ssu viscosity oil in the reduction gears. Adding a partition dropped the ambient temperature 25 to 30 F. Investigation then indicated that a 600-second oil was too heavy, and a 300-second oil was more satisfactory.

Using the lighter oil, decreasing the ambient temperature, and controlling the oil temperature better have materially helped reduce the failures of geared units.

Taken together, all three parts of our program—intensified training of personnel, removing inherent causes of vibration, cleaning up the lubricating oil—have brought us a long way toward our goal of planned maintenance and trouble-free operation.

Timely PRACTICAL IDEAS *that will help you do a*

Repair-welding of cast-iron sludge-pump impeller in photo saves $20,000

AFTER 14 YEARS' SERVICE, six main sewage-pumps of 90 mgd capacity each needed repairing. Because of excessive erosion (*before* photo, right) vanes couldn't be built up so we welded cast-iron inserts in place (*after* photo, left).

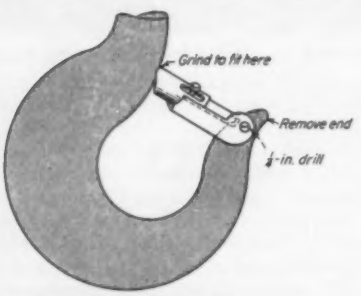
Eroded sections were drilled and cut out with hack saw, sound metal was chamfered for welding. Inserts were also chamfered to give 75- to 90- degree V between plate and vane for depositing weld metal.

We had inserts cast, welded them in place and ground them to a smooth contour. We used a low-amperage electrode to fill worn areas, weld inserts in place.

We repaired an old spare impeller first, filled in eroded areas, then substituted it for the No. 1 pump, etc, until all six were completed. Pattern of insert was made from plaster mold of damaged area, transferring to pattern. Then we cast them.

Because of low amperages needed, no preheating was done. Castings were never heated enough to show color during welding. We used a 5/32-in. electrode. About 150 amp were used at beginning of weld. To keep temperature down, we deposited about one inch of weld at a time, first at bottom of depression, then at one side, other side, then back to bottom, see sketch. This skip technique kept heat to minimum, avoided residual weld stresses. As casting warmed from welding, we reduced amperage to 100 amp, thus further reducing the input into the base metal.

Courtesy—Eutectic Welding Alloys Corp



Crane safety latch that is really safe

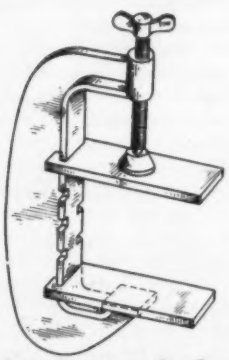
MOST LOADS spill while hoisting to jigs or forms over kettles, vats or plating tanks. Then load may hang up as it catches on rims or frames of device to be landed on. Brief slackening of sling allows loop to slip over hook point. Miscalculation by crane's man, and another spill takes place.

Most safety latches have weld-metal to weakest neck of hook. Then excessive weld heat may ruin much of needed metal's temper at that vulnerable point. Other latches have drilled hole at side of neck, thus removing metal that cannot be spared at critical point of hook's design.

Safety latch, sketch, has drilled hole, but it's placed where it doesn't weaken hook—at hook's tip. No metal is removed or heated at hook's neck in the hazard zone. Latch also has advantage of being operated by one hand. Other hand is free to remove or place sling as work requires. Most other latches require the "hooker" to hold hook with one hand as he overcomes spring tension of device with other hand. Then a second person must hook or unhook load.

You can easily make this little latch in average machine shop. Use a spring inside latch that's strong enough to hold latch firmly against hook.

P C ZIEMKE *Oak Ridge, Tenn.*



Here's a better C clamp

CONVENTIONAL SHOP C-CLAMP is made more useful by filing a series of notches on the clamp's ribs, *sketch*. Notches are for auxiliary jaws of flat steel stock, which extend width of clamping area. They help clamp to be used on uneven surface, with either one or two jaws.

W B LANGEVIN *Concord, N. H.*

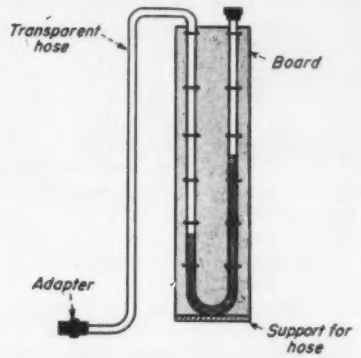
better operating and maintenance job

STEVE ELONKA, *Associate Editor*

Fast trouble indicator

INSTALLING a numbered disk behind conventional pilot light saves many trips for plant electricians. When a motor breaker trips, number in pilot lamp shows correct breaker and starter to reset. With different voltage panels, corresponding colors can be used in pilot-light jewel, which identifies circuit-breaker panelboard door and motor-starter locations. This saves time.

L W FITZPATRICK *Jefferson City, Mo.*



Why not transparent hose for your manometer?

EVERY NOW AND THEN a power engineer has to make a long-necked manometer for measuring pressure. Former practice was to connect two long pieces of glass tubing with rubber hose for U part of manometer. Trouble was in sealing rubber tube to glass tubing.

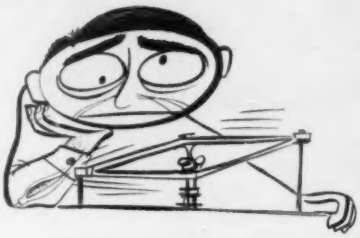
Since rubber hose is usually used for U part anyway, why not make entire manometer of transparent garden hose, secured to wood board by metal staples, sketch. Adapters for either end of garden hose can be bought from any hardware store. These adapters have a hose thread on one end and pipe thread on other. Transparent hose is cheap and won't break if someone comes in contact with it, smashing against board.

G G AVANT *Washington, N. C.*

How friction tape saved the day

SUPPLIER SENT US a gage glass for a generator bearing that was much smaller in diameter than the one ordered. But old glass was cracked and leaking, so we wound friction tape around new one at top and bottom. This centered glass in guide, placed tube bore over hole leading to oil reservoir. No leaks now.

A D ALLEN *Aspen, Colo.*



What would you have done?

SAWMILL DIESEL POWER-PLANT had been running for years without trouble. During the day it powered sawmill, at night supplied power for backwoods village. But when the smash came, no one knew what to do.

Rocker arm on exhaust valve of No. 3 cylinder fractured at bearing point (fulcrum). There were no spares. They tried fixing it with straps, but it didn't work. Someone suggested that garage 50 miles down the road could weld it. Phone buzzed railhead 150 miles away. An order for a replacement was sent to a manufacturer 1500 miles away. That order would take ten days or more to go through.

But garage man made a mess of the welding job. By then the sawmill men were milling around, and manager looked anxiously at his schedule. He looked at the diesel and cussed a blue streak.

Then an old cutter remembered that as a young man on the Great Lakes he'd seen something like that. But he was laughed out of the plant shed. "There were no diesels in 1880," he was told.

Like a drowning man clutching a straw, the manager asked the old timer to explain. The cutter sketched on dirt floor with a stick. Sketch was a twin-lever attached to low-pressure crosshead of a compound steam engine that drove two pumps. He explained that, when the main engine ran, one pump fed the boiler, the other pumped ship's bilges. When feed-pump lever broke, ship's engineer changed bilge-pump lever over to feed pump and said, "To hell with the bilges, we'll bail 'em out with a bucket."

The manager tried the idea. They took the air-inlet valve's rocker arm off and placed it on exhaust side. Engine was started but didn't run well. Then someone remembered something about suction. So they put in a weaker inlet-valve spring. With new spring there was just enough tension to keep valve in its place. Now engine could open valve on downward stroke and close it on upward compression stroke. Engine's output was slightly reduced, but it ran until the new part arrived—two weeks afterward—and that's what they wanted. What would *you* have done?

C MORGAN JONES *New York, N. Y.*

Here's what I'd do for CT's August headache

TO STRAIGHTEN OUT boiler-water level (POWER, Aug 1954, p 125).

First, I would blow down the boiler that had high water and fire her up so I would have enough steam to operate my feed pump. Then I would bring the other boiler up to right water level and fire it up to get it back on the line and start the plant.

Next, I would get busy and repair or replace the valves in all my feedwater lines. As soon as I could take the boiler with low water out of service, I would check its blowdown valves as that is where the water went, causing a low supply. At least that's what I think.

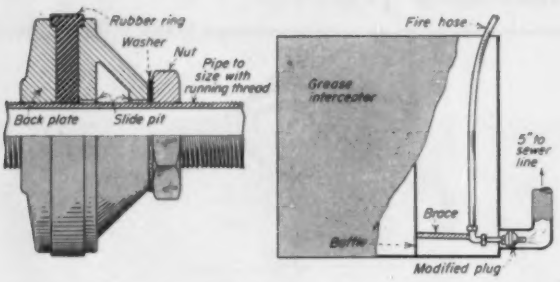
CT did not say anything about the third boiler that probably could have been used to get up steam to operate the feed pump. While he did not give the feed pressure from the pump, I'm sure the water did not go from one boiler to the other to cause low water in one boiler and high in the other. Also, water in low boiler could not have been very low or he could never have gotten enough through his leaky feed check-valves to equalize levels, as he claims.

E P HENNING *Anchorage, Alaska*

(*Continued on page* 132)

More PRACTICAL IDEAS

Begins on page 130



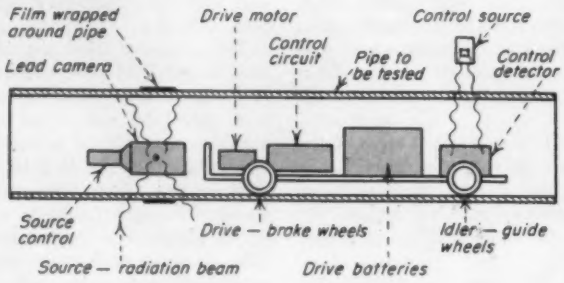
Here's your 'trick' of the month

LOW RATE of flow through oil-interceptor discharge lines caused clogging after some time. Flushing lines to the interceptor and cleaning it presented no problems except that it was a dirty job.

But to clean discharge line to sewer, pressure flushings proved the answer. We did it easily with rig shown in sketch. Standard plumber's test plug is modified as shown. Make so it just fits into discharge opening when rubber ring is slack. Taking up on nut expands ring and makes tight pipe seal. Brace it so water pressure won't blow it back out.

Fire hose connected as shown gave us plenty of volume and pressure for thorough washing out of discharge line. Giving it this treatment about twice a year ended all our troubles.

E ECKERT *Fanwood, N. J.*



Pipe leaks can be found with isotopes

IN JUNE 1954 POWER, p 137, J W Blake finds vacuum leak with shellac. My sketch finds piping leaks with isotopes.

Camera containing isotope is at unit's front. When this source is exposed, gamma radiation is emitted in a narrow beam through 360 degrees. An electric motor powered from storage batteries and controlled by a radiation detection device moves internal camera unit through pipe. Control detector or "brain" is at rear of assembly.

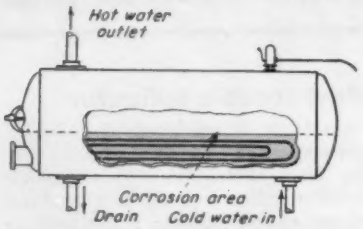
Film is wrapped around pipe and control source placed at a fixed distance from part of pipe to be tested. Internal camera moves automatically inside pipe. When detector reaches a location below control source, a trigger cuts out motor and applies a brake. At this point exposure source is aligned directly with film, which is wrapped around pipe. After a controlled exposure time, unit is automatically released to resume travel until it is stopped by control source again, as in previous operation.

Small pipelines that cannot use this equipment use a portable camera (25 lb weight) clamped in any position around outside of pipe.

Film in a special holder is fixed around pipe's outside. Camera contains iridium in a revolving lead barrel, which can be rotated manually from a safe distance by a long flexible shaft. This method permits inspecting an area exceeding 180 degrees with one exposure.

Either of these methods requires personnel experienced in this type of work, since radiation hazard is present. Although costly to use, results are quickly obtained that permit placing equipment on line and resuming operations in minimum time. Often this time savings will more than pay for high cost of using isotope for detecting leaks.

H B WAYNE *Brooklyn, N. Y.*



Watch for corrosion in hot-water storage tanks

CORROSION CAN BE COSTLY in condensate and hot- and cold-water tanks. You can prevent pitting and wasting away of shell plates and head by brushing away corrosion until bright metal shows. Paint cleaned areas with a rust-preventive paint.

Annual inspections and cleanings prolong tank life. Take care with old tanks. When you don't know thickness of tank metal at corroded sections, drill a ¼-in. hole through plate, measure thickness. Inspect all water connecting pipe-ends in nozzles and shell plates for wasting away. Close nipples on tanks are bad; use either noncorrosive material or extra heavy fittings. Keep manholes and handholes dry. Seepage from cleanout plugs should be stopped. Replace plugs and tap out threads to stop leakage. Keep all flanges dry.

Don't use dead-weight relief valves. These have a small opening for needle valve, cannot be tested by hand. Over a period of time, valve freezes in seat and cannot open. Replace all such valves with ASME standard spring-loaded valves with test lever. Relief valve outlets should be carried to sewer or location so waste cannot flow over tank or appliances. Examine tank supports and keep free from corrosion.

Examine appliances such as water gages, steam coils, relief valves. Clean and test annually. Leaking stop valves on water or steam lines should be replaced as soon as possible.

A source of trouble in condensate tanks is contamination of condensate with outside elements, also from leaking return pipes buried in earth, or acid in tanks. Oxygen leaking through gaskets also creates active corrosion.

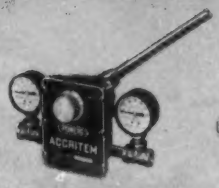
J M GORRIE *Lansing, Mich.*

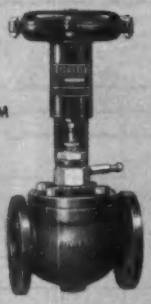
Handy test lamp

INSTEAD OF the usual bulky standard-base test lamps, I use a pair of 6-w 120-v candelabra-base lamps such as GE type S6. Or you can use four of them for 440 volts, if desired. Tape together or set in wood, end to end, or in parallel.

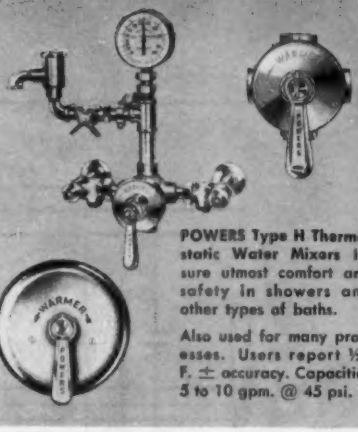
J TRNCAK *Houston, Texas*

(*Continued on page* 134)





Above: POWERS ACCRITEM Temperature Regulator, is water or compressed air operated. Controls FLOWRITE diaphragm valve (right). Widely used for Water Heaters and Industrial Processes.

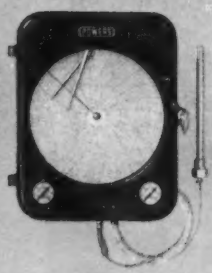


POWERS Type H Thermostatic Water Mixers insure utmost comfort and safety in showers and other types of baths.

Also used for many processes. Users report ½° F. ± accuracy. Capacities 5 to 10 gpm. @ 45 psi.

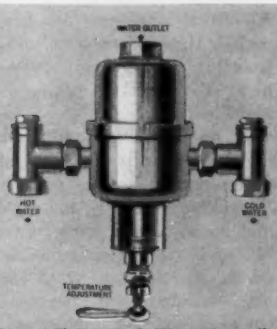
Powers No. 11 Self-Operating Regulator widely used for water storage heaters, heat exchangers, fuel oil preheaters and many industrial processes.

WATER Temperature CONTROL?

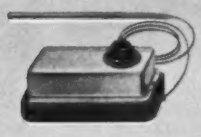


Powers Series 100 Recording Controller. Compressed Air Operated.

POWERS FLOWRITE V-Port-Characterized Diaphragm Control Valve.



Powers Thermostatic Water Controller for regulating temperature of multiple-type showers, hydro-therapy and industrial processes. Capacities 22 to 125 gpm. @ 45 psi.



Powers Remote Bulb Type D Thermostat for Unit Air Conditioners.

POWERS PACKLESS VALVES

For controlling chilled, or heated water in unit air conditioners.
No leakage
No packing maintenance

Call POWERS

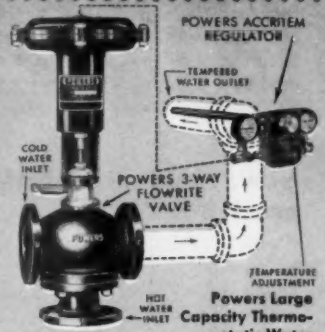
Most Complete Line of Controls Made Only a few are shown here

for All Types of Baths, Water Heaters and Heat Exchangers

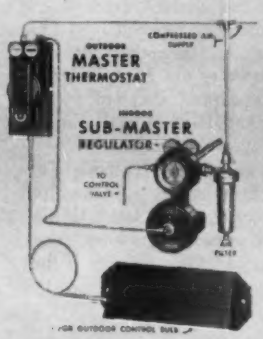
- Forced Hot Water Heating Systems
- Radiant Panel Heating Systems
- Air Conditioning Units using Chilled and Heated Water
- Cooling Water for Air Compressors, Diesel, Gas Engines, and Cyclotrons
- **Many Industrial Processes:** Photo Developing, X-Ray, Color and Ordinary Film, Lens Polishing and Grinding, Chocolate Enrobers, Plastic Molding Presses, etc.

Our More than 60 Years Experience will be valuable in helping you select the right control for your requirements. Contact our nearest office or *Write us direct for Condensed Catalog Rb 24.*

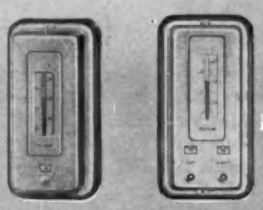
THE POWERS REGULATOR CO.
Skokie, Ill. • Offices in Over 50 Cities in the U.S.A., Canada and Mexico



Powers Large Capacity Thermostatic Water Mixing Valve Controlled by an ACCRITEM Temperature Regulator. Capacities 20 to 1200 gpm. @ 45 psi.



Powers MASTROL Control for regulating forced hot water heating systems.



Powers Room Type Pneumatic Controls for Radiant Heating-Cooling Panels, Convectors and Unit Ventilators. Valves are packless. No more packing maintenance. No leakage.

(b61)

More PRACTICAL IDEAS

Begins on page 130

Carbide-tipped saws save money

A SWITCH four years ago from steel to carbide-tipped, cross-cut and rip saws is saving the shipping operation at one plant thousands of dollars annually. Short-leaf yellow pine, a very tough wood on saws because of sand and mineral inclusions, is used for crating. The green lumber makes cutting difficult.

Before switching to carbides, the high-speed steel swing cross-cut saw blades lasted a maximum of one day. On exactly the same stock and application, carbide-tipped saws run 240 days. On their rip saw, high-speed steel ran 2 hr; carbides run 86 hr before regrind.

Savings are from not having to make saw changes, grinding and extended life of carbide over high-speed steel saws.

Stock up to six inches thick is cut on both saws; cross-cut saw operates at 3600 rpm with a 4-hp motor. Rip saw is run at 3600 rpm, also, but it is powered by a 20-hp motor. It has a feed of 48 feet per minute. See photo, above. *Courtesy, Carboloy, Dept of GE*

Now, radioactive isotopes are the operators tool

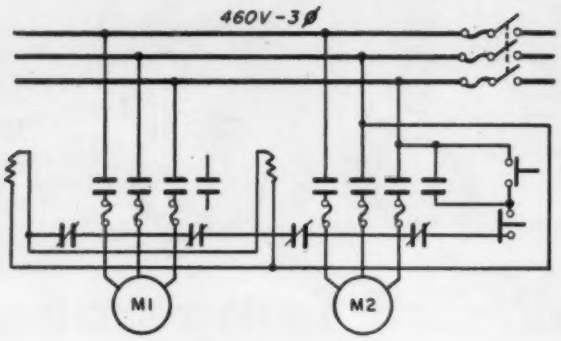
HANDS of punch press operators spotted with radioactive materials will stop a punch press in midstroke should an accident-provoking move be made.

Objects traveling through pneumatic tubes are spotted with radioactive materials so their location is quickly determined. Should underground pipelines leak or clog, radioactive particles put into the lines find and determine points of disturbance easily.

Commercially available noncontacting gages measure thickness of continuous sheets of material. Variation in thickness changes flow of radiation. Increased knowledge of radioactive materials gives much higher precision in detecting flaws in materials, and in measuring wear of such articles as piston rings, tools and dies.

CAUTION: Use radioactive materials only as advised by a competent chemist.

L GOLDRING *White Plains, N. Y.*



Synchronized starting-stopping of identical motor

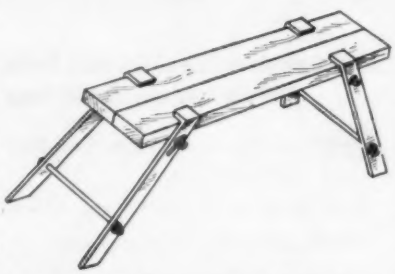
GRINDING COCOA BEANS called for two 20-hp motors, driving identical equipment to start and stop with split-second time lapse between units.

Original setup had both the stop-start stations adjacent to each other. Thus, two men could do a fair job of starting and stopping "on the money." One man with a hand on each switch could do just about as well. But there came the fateful day when one grinder developed mechanical trouble and the increased load caused thermal link to trip out the magnetic switch. That allowed second motor to keep driving grinder. But grinders in series make a big mess.

Diagram shows how internal wiring of two magnetic switches was rearranged, also pushbuttons for simultaneous starting and stopping features. These have an added precaution: Should one motor trip out, the other also trips out instantly since protective features are in series in relation to each other.

This type circuit was also used on a belt conveyor, powered in cascaded sections by four motors. Here, to compensate for voltage drop between magnetic holding coils, wired in series, special coils were furnished to operate at one-fourth the rated line voltage.

P C ZIEMKE *Oak Ridge, Tenn.*



Homemade portable work bench or staging

HERE IS A PROJECT for your mechanic that'll pay off in handiness, usefulness and sturdiness. We call it our knock-down work bench. It's made from two 12-in. planks and a pair of frames or legs, sketch. Frame legs are self-clamping. The more weight you place on bench, the tighter the legs clamp.

Legs are made from 3x½-in. flat-steel bar stock, taken from an old truck body. Rods are part of legs and are ⅝ in. Bottom rods are a foot longer than top rods to spread legs on bottom.

H WILLEY *Concord, N. H.*

Did you know . . .

THAT OXYPROPANE for burning steel and brazing with presently available equipment has these advantages? Contrary to popular belief we have found the following conditions:

(1) Less oxygen is used. (2) Cutting is faster. (3) Fuel cost is presently one-tenth that of acetylene, delivered in New York City (Btu dollar). (4) Total gas-cost saving varies between 17% and 37%. (5) Fewer cylinders are handled. (6) Precleaning or chipping of rust, dirt or paint markings is unnecessary. (7) There is less surface hardening if cut must be machine finished. (8) Less slag adherence and smoother cut. (9) Propane is safer to use because it (a) has narrower explosive range (b) is nontoxic if inhaled (c) is easier on the eyes.

Propane is universally available. Conversion from acetylene to propane often requires merely changing torch tip and mixer. Use of present regulators, gages, hoses and equipment is possible if they are in good condition.

J CAVE *New York N. Y.*

more than a million!

YARWAY®

impulse® steam traps

Starting in 1935, this new idea in steam trapping has earned wide acceptance and approval in practically every industry using steam. More than a million Yarway Impulse Steam Traps have now been sold.

Why? Ask any user. You'll hear reasons like these:

"Quick heating. High, even temperatures"

"Low maintenance"

"Small size, light weight"

"Stainless steel body and working parts"

"Good for all pressures"

"Only one moving part"

"Low cost"

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More than 250 Industrial Distributors in the United States and abroad stock and sell Yarways. Write today for the name of the one nearest you.

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100 Mermaid Ave., Philadelphia 18, Pa.

Cut-away section of Yarway Impulse Steam Trap showing only moving part, a small stainless steel valve

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PLANT PROBLEMS . . . *helpful info from readers*

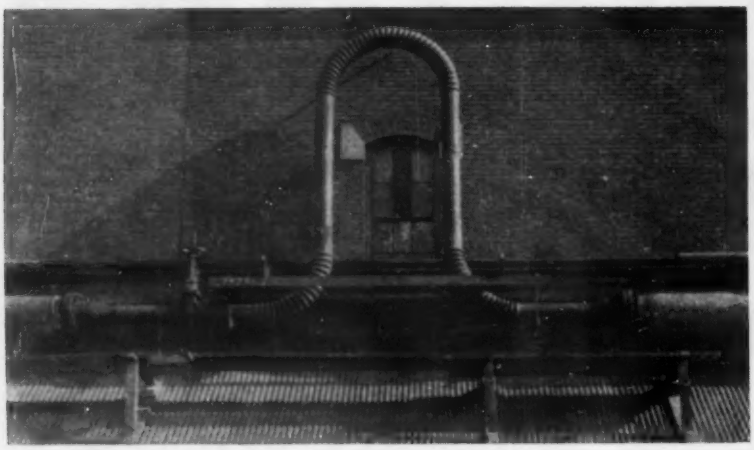
Is corrugated piping still suitable?

HERE ARE THE FACTS: I'm senior staff engineer for a large consulting firm doing many steam-plant jobs. Recently we ran into some tough expansion problems and I suggested corrugated piping would solve them quickly.

Opposition was not only strong, it was also heated. Yet my calculations show this pipe often saves money and space without danger to personnel. And as far as appearance goes, it can be insulated to look like regular pipe.

Why all this opposition? Does experience show this type of pipe is unsafe?—*MF, August Power*

Here are the answers



CORRUGATED PIPING ON THE JOB

Above: An 8-in. corrugated expansion U bend, 36 ft long, made of extra heavy steel
At the right: This shop-fabricated bend is for use in a steam power plant pipeline

CORRUGATED PIPING offers increased flexibility that may be of real value in certain tight installations. Though plain piping may be preferable, corrugated often solves tricky expansion problems, especially in steam lines. It offers flexibility where space, clearance and weight are important. It gives maximum piping flexibility with minimum length.

The Code allows a stress intensification factor of 2.5, a flexibility factor of 5. Without carefully controlled stress relieving, corrugated piping is not advisable for high pressures where longitudinal axial force tending to lengthen the pipe is large. There is no reason to fear this effect in lower-pressure piping. But, of course, stress relieving should always be carefully done and well controlled.

It is preferable to place corrugated piping in a vertical position, if possible. In a horizontal position water may accumulate in corrugations. This could induce additional local stresses because of the temperature difference across the corrugations.

Tests of corrugated piping show a fatigue endurance less than that of plain pipe. Failure starts at crest of a corrugation; cracking progresses outwardly. Photos show typical corrugated lines.

FRANK KAMARCK *New York, N. Y.*

For your two new problems, turn to page 140

FOR SHORT SPANS of low-pressure pipe where temperature changes are small, corrugated piping can be successfully used. But for higher pressures and where there are frequent and large temperature changes, a slip-tube type expansion joint offers more rugged and durable construction, along with a large traverse. Joint should be the type that can be repacked under pressure.

This thinking is based on the fact that fatigue is an important factor in pipe expansion, particularly when the installation is intended for long service. Fatigue of corrugated elements depends directly on the frequency and magnitude of changes in their length. Also, corrugated piping is probably much more expensive than regular pipe and more difficult to insulate properly.

Pressure drop due to turbulence is considerably higher in corrugated pipe and this factor assumes increasing importance with long lines and high velocities. So for a given flow of steam a larger-diameter corrugated pipe is needed. Since corrugated pipe is about five times as flexible as ordinary pipe, long spans require considerably more support and a larger number of alignment guides.

Corrugated pipe undoubtedly has a place as one of numerous methods for absorbing pipe expansion. But we recommend caution and careful consideration of the above factors. Alternative

on corrugated piping and boiler-load swings

TYLER HICKS, *Associate Editor*

methods — expansion joints, loops, bends, etc—should be considered and the decision based on a very careful study of all the factors.

K ROBERTS *Yarnall-Waring Co,*
F PTACEK *Chestnut Hill, Pa.*

ABOVE 300 PSI, fabricated pipe bends are more advisable than standard corrugated expansion joints. Up to about 6-in. diameter, corrugated joints and fabricated bends are about equal in cost. Larger sizes of corrugated joints are definitely cheaper.

When properly installed, corrugated joints give years of satisfactory service. They definitely save space—an important consideration in underground piping where a pit must be provided for each expansion joint.

My preference is for fabricated pipe bends welded into the steam line where they can be forgotten.

WALTER STEINERT *Flushing, N. Y.*

ALL TYPES of corrugated sections—pipe, expansion joints and loops—are suitable for solving expansion problems. But *MF* should remember that no type is always suitable.

Corrugated pipe sections and joints are extremely useful within their limits. Cost is lower, installation easier, and layout can be streamlined for appearance, space-saving and convenience. They are relatively troublefree, requiring little or no maintenance. Corrugations easily accommodate axial and lateral motion, as well as misalignment.

Pressure and, perhaps, temperature limit use of corrugated pipe because as wall thickness increases, so does the expense of corrugating the material. Above 750 F, C-Mo or a Cr-Mo alloy material is needed, increasing the difficulty of making the corrugations.

Expansion joints are similarly limited, perhaps to a greater extent by pressure. However, it is possible to obtain this type of expansion joint for relatively high pressures and temperatures.

Corrugated pipe is intermediate in behavior between bellows joints and straight pipe. It only partly reduces the expansion thrust, but it is unnecessary to anchor the ends. However, tie rods prevent corrugations from straightening out over a period of time, particularly when creep exists. Used with discretion, it is excellent for short, straight runs.

Offsets or expansion loops are preferable for securing flexibility, and can be used for any pressure, temperature and material. Welding fittings are often suitable for absorbing thermal expansion. Be sure piping is well designed when using these fittings.

A J BREUGELMANS *New York, N. Y.*

DISADVANTAGES of corrugated pipe outweigh its advantages. One fact sometimes overlooked is that this type cannot be used for a metering run because flow ahead of the meter is disturbed. Perhaps its best application is for cases where advantages fit special conditions.

A M PALMER *Brooklyn, N. Y.*

MOST OPPOSITION to corrugated piping comes from incorrect installation. Some engineers think it can be used just like flexible hose.

Properly engineered corrugated piping and joints require almost no maintenance, and are excellent when lines run in ducts and narrow tunnels.

L W FITZPATRICK
Jefferson City, Mo.

A TWO-THIRDS thrust reduction is one of the outstanding advantages of corrugated piping used for power service. This is especially important for turbines and other equipment having an upper limit for thrust loads. Usually the slightly greater pressure drop met with is not of enough magnitude to rule out corrugated piping when other factors favor its use.

For some applications the cost of straight pipe with bends or loops, or both, may be higher because of the greater lengths needed in manufacture and the large amounts of alloying elements used in high-temperature service.

Experience shows corrugated pipe gives satisfactory service with possible elimination of some hangers and supports, lessening operating and maintenance problems. Best way to compare the cost of the two types of construction is to secure estimates from fabricators and installation contractors.

H B WAYNE *Brooklyn, N. Y.*

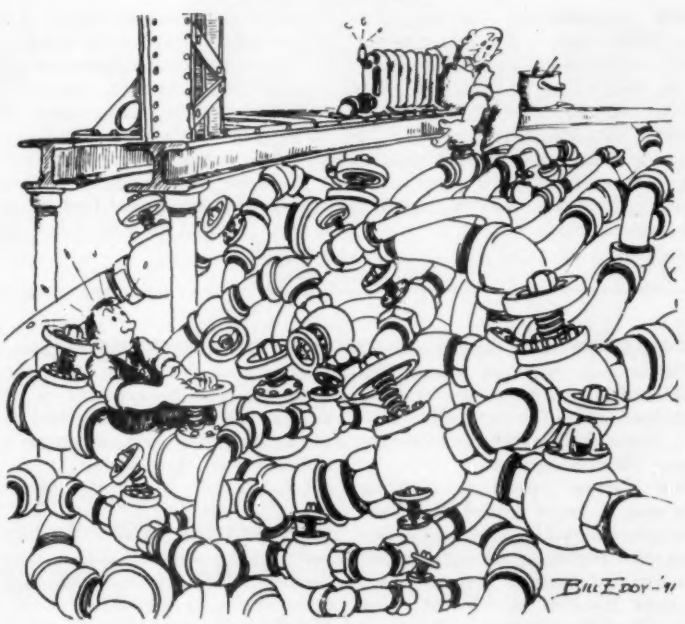
ONLY SELLING POINT for *MF* is installation economy. But I agree that for best results corrugated piping must be very carefully manufactured for use in a particular installation.

CLYDE HOWARTER *Canton, Ill.*

(*Continued on page* 138)

No. 10 of the Bill Eddy cartoons

Repeated by request



"Now, Henshaw, let's look at this problem logically."

More PLANT PROBLEMS

Begins on page 136

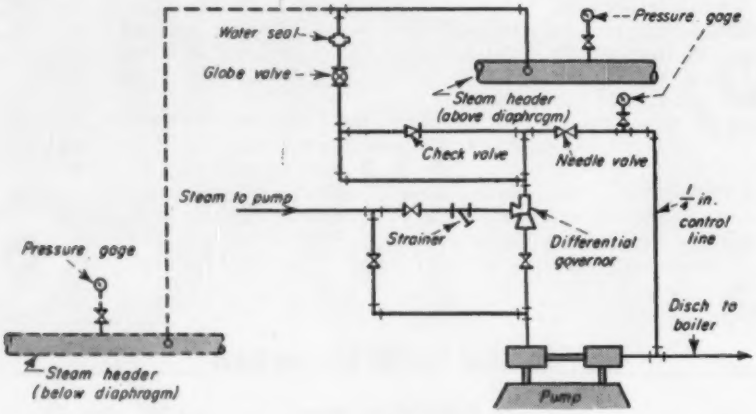
Why do boiler loads swing?

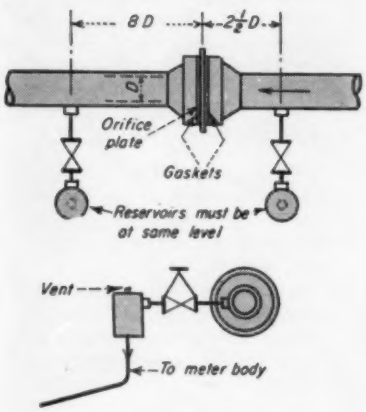
HERE ARE THE FACTS: We have three stoker-fired watertube boilers fed by reciprocating feed pumps. Feed enters front headers of each unit.

Our charts show the steam header pressure is fairly constant at 120 psi, with a maximum variation of 18 psi. But each boiler flowmeter shows wide swings, usually on opposite cycles, with each unit alternately taking the load.

What causes this? Nonreturn valves do not seat during the swings. Gas temperature in first pass varies 300 to 400 F during the swings. How is efficiency affected?—*AR, August Power*

Here are the answers





CHECK FLOWMETERS for accuracy. Leads from orifice or flow tube may not be correctly piped, permitting air pockets to form. This leads to pulsations and surges. Leads must be pitched correctly to allow noncondensables to vent. Right sketch is typical installation. If there is any doubt about meter accuracy, have an engineer from the manufacturer check it.

Left sketch shows the correct hookup for a direct-acting steam pump controlled by a differential-pressure governor. When pump and governor are operating properly, an increase in steam output produces a proportional rise in feed flow, pump discharge pressure.

With the boilers under automatic combustion control, fuel feed increases to meet the need for greater heat input to the furnace. Variation in first-pass gas temperature, *AR* notes, results when fuel feed is increased but feedwater flow remains fixed. The water cannot absorb the larger heat output from the furnace at a high enough rate to prevent an increase in flue-gas temperature. See that combustion-control equipment is functioning properly.

H B Wayne *Brookyln, N. Y.*

For your two new problems, turn to page 140

FUEL-BED CONDITIONS, damper troubles or intermittent feed can cause *AR's* troubles. Different firing rates or firing conditions can lead to one boiler carrying a larger share of the load than the others. Then swings occur.

Poor damper operation, resulting from wear or faulty control, also leads to swings. Check CO_2 from each boiler to see draft regulators are set properly.

Intermittent, uneven feeding causes the same troubles as different firing rates. Check feedwater regulators.

S F Wilson *Princeton, N. J.*

CONSTANT - PRESSURE TYPE controls, when each boiler has its own master controller, can be expected to allow swings. See control manufacturer about the possibility of using one master controller for all three boilers.

L G Nelson *Pensacola, Fla.*

COMPARE STEAM LOAD with boiler capacity. From what *AR* says, it appears the boilers are lightly loaded. Under these conditions they often swing, especially if the controls are too sensitive. Correct loading saves fuel and gives more stable output. So he may find the swings can be eliminated by carrying the load on less than three boilers.

Check needle valve in air-operated combustion-control system to see it properly dampens the impulse from the master control. If the valve is not properly adjusted, it can cause excessive hunting in the system.

The feed pumps may not be properly governed, causing one boiler to receive more water than others. Check governors or regulators. Of course, automatic

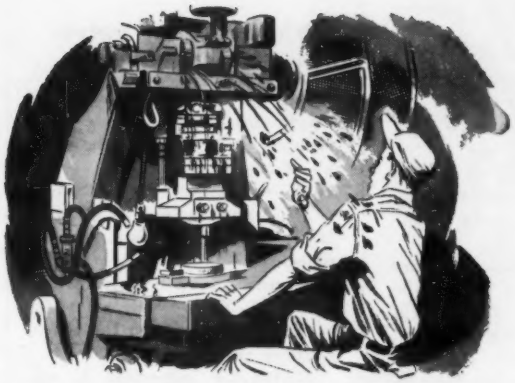
(*Continued on page* 140)

SAME TROUBLE in our plant occurred when two identical boilers were fitted with but one electrical and air combustion-control board because of wartime shortages. This threw us off the track until we found our real trouble was in the single-element feedwater regulators. We cured it with 3-element regulators.

If 3-element regulators cannot be justified, *AR* might be able to get by with one boiler on base load manually controlled and another automatically controlled taking the load swings. Feed regulators seem to level off after a short time on a constant base load.

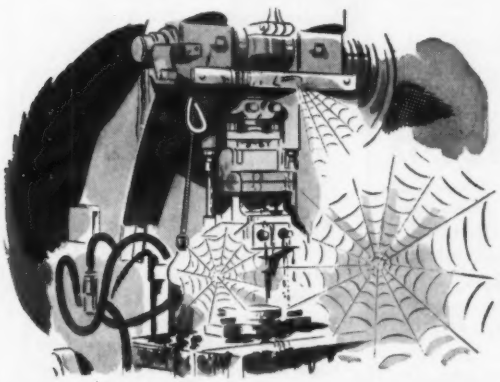
Howard Holcombe *Los Alamos, N. M.*

No Downtime in Three Years After Switching to Suntac

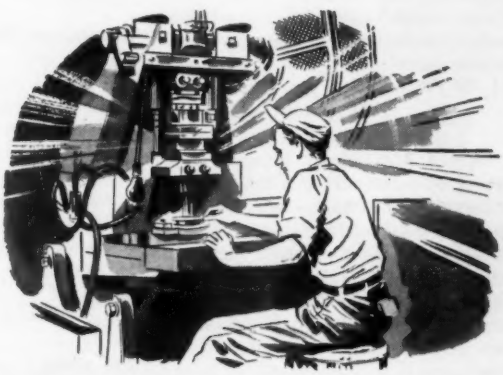


Metalworking firm was using heavy-duty stamping presses of an older type. Bearings were wearing excessively. Oil leaked constantly—on machines, floor and operators.

Lubricant loss was so severe that bearings frequently became so hot the machines had to be shut down until the bearings cooled. This cut sharply into production.



Bearings had to be replaced on an average of once every eight months. Repairs usually took four weeks, and during this time the machines as well as the floor space were completely non-productive.



Manufacturer switched to SUNTAC because it's especially compounded to cut leakage. No breakdown now for over three years. Oil consumption reduced 50%. Also using SUNTAC to lubricate other equipment.

Do you have machines with worn, leaky bearings? Or are you losing oil through excessive throw-off from rotating or sliding parts? SUNTAC is especially compounded to reduce drip, splash and squeezeout. Its greater adhesiveness makes it cling firmly to the parts it lubricates. Get all the facts about SUNTAC from your Sun Oil representative. Or write Dept. P-11.

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Refiners of famous High-Test Blue Sunoco Gasoline

More PLANT PROBLEMS

Begins on page 136

control of boiler feeding is far superior to manual control.

A variation of 300 to 400 F in flue-gas temperature represents a serious efficiency loss and can cause many brickwork headaches. I would expect spalling troubles if this condition continued indefinitely.

WALTER STEINERT *Flushing, N.Y.*

FEEDWATER FLOW RATE to each boiler does not appear to be constant. Water level in each boiler probably fluctuates. Check feed regulators. If they are not fitted, *AR* should seriously consider installing them.

Feeding through the front headers is not too good. Distribution of feed through lower tube bank may not be good. It would be wise to consult manufacturer and insurance company about changing the feed to the boiler drum. Distribution, performance and efficiency will be better. Two boilers might carry this load instead of three.

C G ROBINSON *Dubuque, Iowa*

OVER-CONTROLLING FEED gives a sawtooth flowmeter record. Fuel-burning equipment and settings suffer, while flue-gas temperature rises. Adjust combustion controls to minimize this effect. Be sure pump governor is set correctly.

L W FITZPATRICK *Jefferson City, Mo.*

A FAULTY BOILER may interfere with correct operation of other units. This means *AR* must find which boiler is operating incorrectly. Over- or under-sensitive automatic controls lead to swings. Excessive lost motion or binding at one or more places in the control mechanism may also lead to swings, but they may not always be exactly the same.

Burned or dirty contacts in electrically operated controls are another trouble source. See that reset or compensation adjustments are correct.

Best bet is a complete check of *AR's* entire control system for any faults that might be inducing these swings. Feedwater, air and furnace-draft controls may be at fault.

A W GOULD *Lowell, Mass.*

FEEDWATER REGULATORS are probably at fault, even though there is no visible change in pump speed. Boiler efficiency falls off, as shown by the large variations in flue-gas temperature. Reduce sensitivity of feedwater regulators to eliminate cycling.

A W MACFARLAND *Burlington, N. J.*

SWINGS in water level may be the cause if level in each boiler is automatically controlled. These swings can be caused by a high differential pressure between the pumps and boiler. One boiler takes more than its share of water, dropping part of its steam load until the regulator closes off. Then it picks up the load again. This cycle repeats in the other boilers.

Lower the differential pressure. Have representative of regulator company check conditions in the plant.

RICHARD CONK *Newark, N. J.*

OUR PLANT has load swings of 5000 to 10,000 lb per hr every few minutes. Stokers and f-d fans are steam-engine driven.

But the boiler and the header pressure vary only one or two psi during the swings. Good governor of the right size and correct diaphragm control range gives us these results.

Keep draft in furnace balanced by closing it when load falls, opening it when load increases. Best scheme, of course, is automatic control of damper position.

ART BELTON *Montreal, Canada*

INDIVIDUAL BOILER controls are bucking each other. Control all boilers from one master control, tapping it into the common steam main. Each boiler would still be protected by its own control set at a pressure higher than that in the header.

Another solution is to set boiler controls at different pressure differentials. Change differentials each week so every boiler has its chance of carrying the base load.

J SMITHWICK *Washington, D. C.*

AIR SUPPLY and stoker feed rate are not properly coordinated. Increase in first-pass flue-gas temperature indicates air-ratio increases at a rate different from fuel ratio. We ran into this trouble in our plant.

The first check that we made was to see that air and fuel feed rates were synchronized. Next, we checked maximum and minimum output. We get best operation for three boilers when two are on automatic control, the third on manual.

ROBERT GRAEFEN *Chicago, Ill.*

OTHER READERS sending good answers, for which we lacked space, are:

A A HUNNEWINKEL *Woodstock, Ill.*
HENRY RASMUSSEN *Crystal Lake, Ill.*
C G HOWARTER *Canton, Ill.*

YOUR NOVEMBER PROBLEMS

PROBLEM 1

What's a good valve-overhaul program?

In our plant we have thirty 1-in. diaphragm - operated pressure-reducing valves. Since they are all on important services, we are anxious that they perform well.

What can we use as a basis for inspection, overhaul and replacement of these valves? How often must we open them for inspection? What is the safe life of the diaphragm and the other working parts?

If regular inspection is required, how can we simplify the work? I've heard about test stands, but do not know how to construct one. What kind of program should be used with a larger number of valves?—*SH*

PROBLEM 2

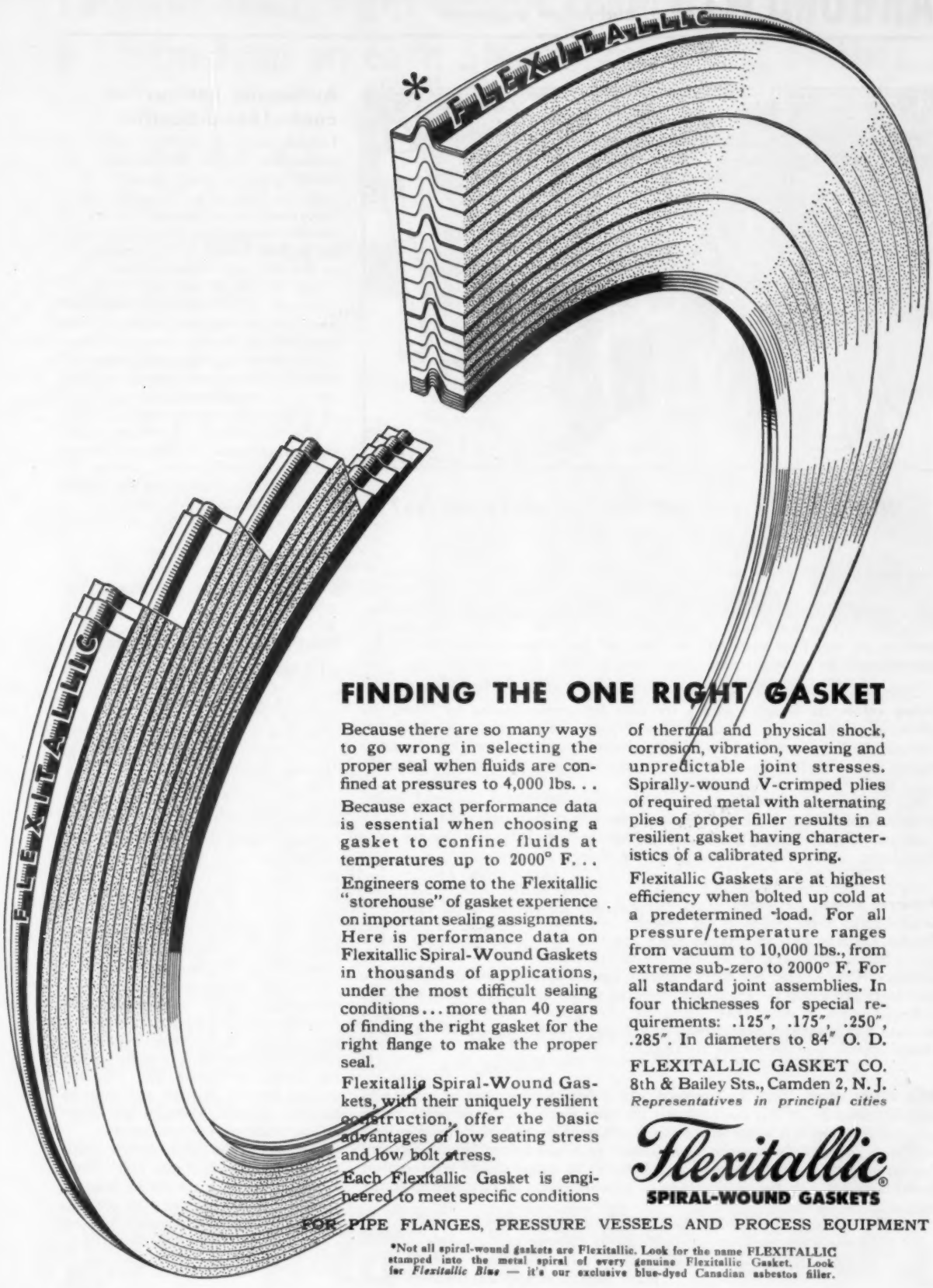
How can we control diesel cooling?

We have three 1200-hp diesels in our industrial plant. They drive generators supplying dc for process electric loads. Each engine has its own cooling tower.

Recent water shortages and high ambient summer temperatures have caused trouble with engine cooling. It takes almost all an operator's time to keep the engines at a safe temperature on a hot day.

What kinds of controls can we use to regulate cooling-water temperature, shut the engine down when water temperature is too high, and warn the operator? Is it possible to use controls on each tower, or must they be fitted to the engine? Which control system gives the best protection?—*FL*

Will you help readers who sent problems? Extra pay for photos, sketches.



FINDING THE ONE RIGHT GASKET

Because there are so many ways to go wrong in selecting the proper seal when fluids are confined at pressures to 4,000 lbs. . .

Because exact performance data is essential when choosing a gasket to confine fluids at temperatures up to 2000° F. . .

Engineers come to the Flexitallic "storehouse" of gasket experience on important sealing assignments. Here is performance data on Flexitallic Spiral-Wound Gaskets in thousands of applications, under the most difficult sealing conditions . . . more than 40 years of finding the right gasket for the right flange to make the proper seal.

Flexitallic Spiral-Wound Gaskets, with their uniquely resilient construction, offer the basic advantages of low seating stress and low bolt stress.

Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". In diameters to 84" O. D.

FLEXITALLIC GASKET CO.
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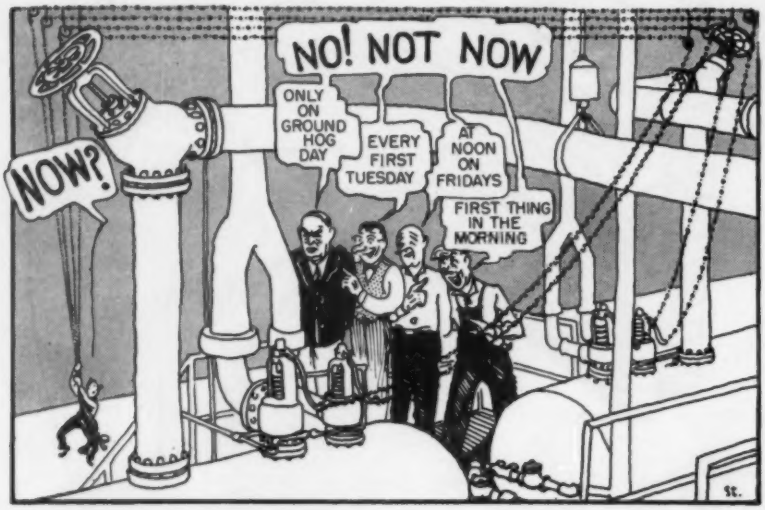
Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

ARGUMENTS

Here's the place to unload your gripes to editors, manufacturers and fellow engineers



When should you test boiler safety valves?

Best practice I have encountered for testing safety valves (August "Arguments") is this: After the yearly boiler overhaul, and before cutting boiler in on the line, test safeties by steam to make sure they are set at proper popping pressures. After that, lift by hand once a week as part of regular routine. This practice prevents the seat from rusting to the disk, and also blows out any dust or dirt that accumulates above the disk.

LIZARDO MARTINEZ *Rego Park, N. Y.*

Safety valves are designed with a try lever for regular testing by lifting. In answer to Steve Edwards' question (p 136, August), for operating pressures below 400 psi, conditions usually permit lifting the safety valves periodically by using the try lever. Too frequent valve lifting causes damage to the seats in a relatively short time. Once a month is good practice.

For pressures above 400 psi, lifting the safety valve during operation causes temporary high-water level, and results in carryover. Test such safety valves at least annually, after removing the boiler from the line. Otherwise, remove valve from boiler during shutdown and test in the shop.

J D COOK *Lake Charles, La.*

Preferred method for testing safety valves is pressure testing, if the steam lost is not enough to cut into plant requirements. If pressure testing is impracticable, Reader Edwards (August "Arguments") can use manual testing. Boiler safety valves have a lifting gear or cam lever for this purpose.

Safety valves are the last line of defense against excessive boiler pressure, so take every precaution to have them in working order. Test at least once a month.

Requirements of safety-valve testing are often given in codes and ordinances of state and municipal authorities, as well as insurance companies. Edwards should consult these for further information.

H B WAYNE *Brooklyn, N. Y.*

Each safety valve should be equipped with a hand-testing lever or other substantial lifting device that can positively lift valve disk from its seat when boiler pressure is within 75% of the safety valve's setting. Use the lifting device at least once daily to test the safety valves, preferably once each operating shift. Record the test properly in the boiler-room log. Safety-valve testing should be prescribed by management with due consideration to possible effects of such testing during certain operating hours.

COURTESY, *Handbook of Industrial Safety Standards*
ASSOCIATION OF CASUALTY AND SURETY COMPANIES

Automatic combustion control has difficulties

I KNOW several plants where automatic combustion control on furnaces has caused grates to overheat and burn.

In one, links of a chain-grate stoker have grown to an unusual degree. In another, tuyeres have burned excessively. In both, trouble is experienced only on the units with automatic control.

You will recall how quickly grates burn out of a hand-fired installation when ash accumulates in the pit and shuts off air flow to the grate. Does automatic combustion control cause this excessive heating and burning of stoker iron when steam overpressure shuts off air while stoker carries a hot fuel bed?

This condition could well be aggravated if additional boilers, without automatic combustion control, were on the line, and their ratings were not promptly cut back when load drops occurred.

B EDWARDS *Cleveland, Ohio*

EDITOR'S NOTE: *Do you agree with this theory? What have you readers observed to confirm or dispute Edwards' experience?*

Start engineer's training at high-school level

NEXT TIME you discuss how to solve the engineer shortage, perhaps you will mention our *Jets* (Junior Engineering Training for Schools) program here at Michigan State.

We had long felt that "the word" about engineering, its requirements and opportunities, had just not been getting through to the high-school student. And we thought every capable and qualified young person should be encouraged to consider a career in engineering or science.

So we organized *Jets* to (1) stimulate interest in engineering among high-school youth (2) offer opportunities to prepare for an engineering career by encouraging good scholarship and proficiency in high-school subjects as prerequisites for college engineering courses (3) provide a preview of the engineering profession (4) help the student discover, evaluate and appraise his own abilities, aptitudes and interests in preparation for engineering.

Members of the clubs take on activities according to their own preferences. Some typical ones are taking trips to factories and construction jobs; presenting engineering and science programs

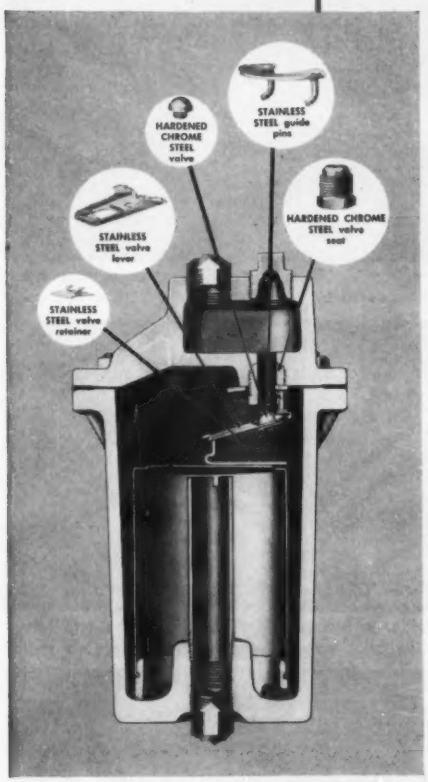
(*Continued on page* 216)

You will always get better results by putting a Steam Trap on each Steam Coil, Chest or Unit

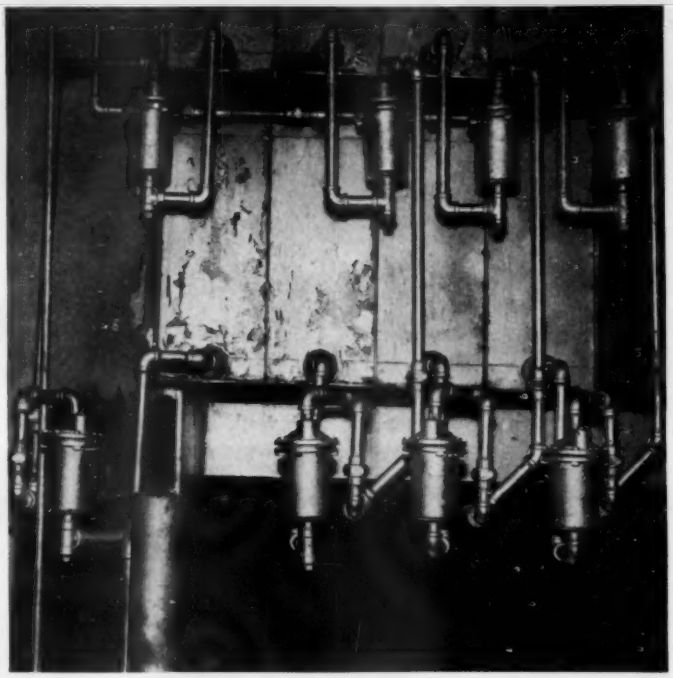
EXAMPLE

Dryer Temperatures at
Guelph Creamery, Guelph, Ontario.

WITH GROUP TRAPPING (5 steam traps for 10 coils)	**225°F**
WITH BLOW-THROUGH (no steam traps)	**250°F**
WITH ARMSTRONG UNIT TRAPPING (10 traps—one on each of 10 coils)	**309°F**


HARDENED CHROME STEEL valve
STAINLESS STEEL guide pins
STAINLESS STEEL valve lever
HARDENED CHROME STEEL valve seat
STAINLESS STEEL valve retainer

One of the big advantages of Armstrong traps is LOW MAINTENANCE. Mechanisms in low and medium pressure traps identical in design, workmanship and materials to those in 900°F, 900 psig traps.



● The example at the upper left is simply one of thousands that bear out the benefits of "Armstrong *Unit* Trapping".

When you analyze it, the reason is quite obvious. No two steam coils, chests, chambers or machines will condense steam at exactly the same rate under operating conditions. There is a greater pressure drop in the units that condense the fastest. Steam will backflow through a common drain line from a higher pressure unit to a lower pressure unit. This blocks off flow of air and retards condensate flow from the lower pressure unit. On the other hand, if you separate each unit with its own trap, that can't happen.

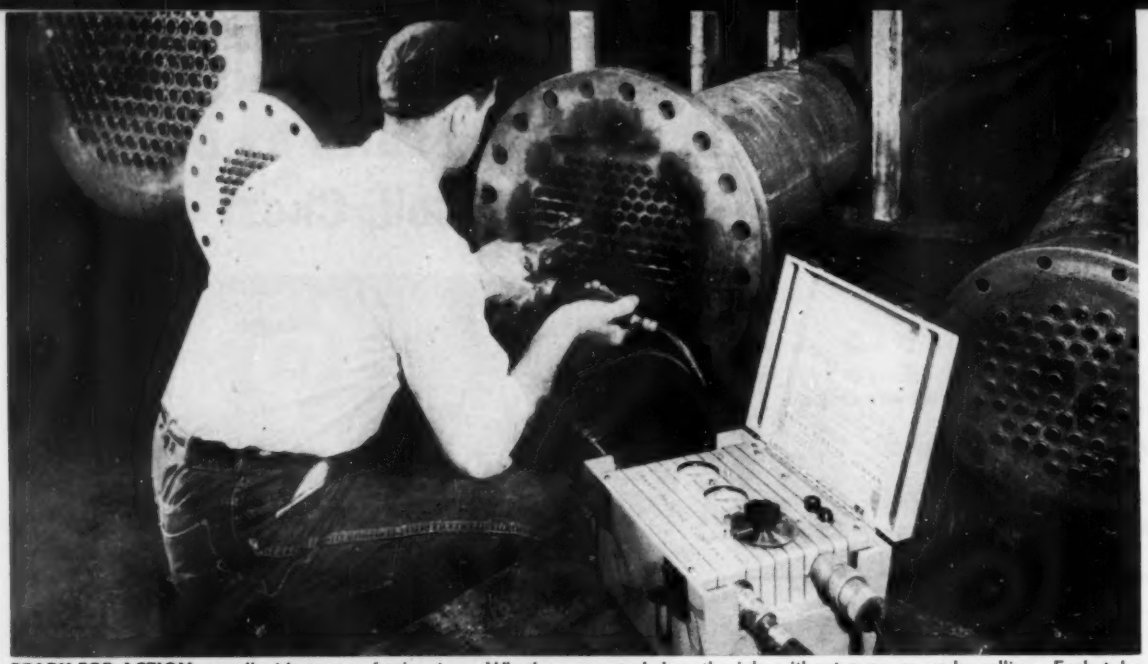
You will *always* get higher temperatures and lower production costs with unit trapping. Ask your Armstrong Representative about it, or write:

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan

FREE—STEAM TRAP BOOK

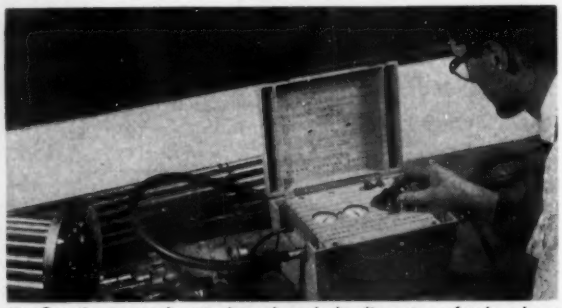
If you don't have a copy of the 44-page Armstrong Steam Trap Book, we'll be glad to send you one. No obligation.

ARMSTRONG STEAM TRAPS



READY FOR ACTION: to roll wide range of tube sizes. Whether ferrous or nonferrous metal, this electropneumatic tube-rolling control does the job, without over- or under-rolling. Each tube is rolled to a set dimension, and all of the tubes are uniform

1 Measure diameter of hole in tube sheet for right setting of electrical control. Only one setting is needed for job



2 Set the control unit, based on hole diameter of tube sheet and OD of tubes to be rolled. This is a simple operation

HOW TO take 'guess' out of tube rolling

► Now, you can roll in your tubes with air and control their tightness so they are neither over- nor under-rolled. Tool is a handy portable electropneumatc unit. The advantages claimed are:

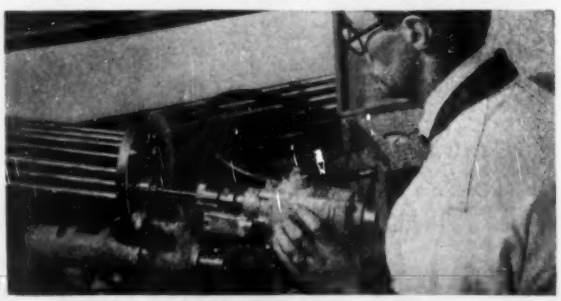
Air-operated motors are better for driving. They allow one motor for wide range of tube sizes: up to 6-in. diameter have been rolled.

Electronic brain controls amount of expansion to tube sheet, tightness and the holding strength to exact values, thus doing away with "weepers" or "leakers." Cold-work stress is minimized and distortion or fracture of ligaments in tube sheets prevented.

Operator does not need to have right "feel," as all tubes are rolled to set dimension.

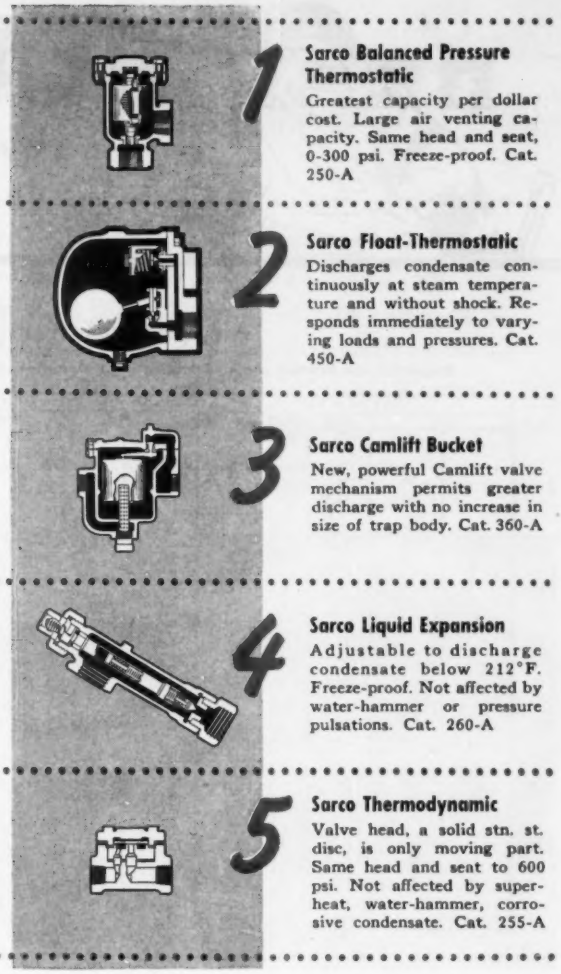
Courtesy, Crane Packing Co, Chicago, Ill.

3 Insert expander into tube and activate air gun with rotating-handle switch. Valve's circuit controls air to motor



4 At right point of tube expansion, torque load on air motor increases, air shuts off and rolling stops automatically

Which type of steam trap is best for your need?



1 Sarco Balanced Pressure Thermostatic
Greatest capacity per dollar cost. Large air venting capacity. Same head and seat, 0-300 psi. Freeze-proof. Cat. 250-A

2 Sarco Float-Thermostatic
Discharges condensate continuously at steam temperature and without shock. Responds immediately to varying loads and pressures. Cat. 450-A

3 Sarco Camlift Bucket
New, powerful Camlift valve mechanism permits greater discharge with no increase in size of trap body. Cat. 360-A

4 Sarco Liquid Expansion
Adjustable to discharge condensate below 212°F. Freeze-proof. Not affected by water-hammer or pressure pulsations. Cat. 260-A

5 Sarco Thermodynamic
Valve head, a solid stn. st. disc, is only moving part. Same head and seat to 600 psi. Not affected by superheat, water-hammer, corrosive condensate. Cat. 255-A

With these 5 different types to offer, Sarco can give you impartial advice

Any type of steam trap will do "some kind" of a steam trapping job for you.

But there's a world of difference in trapping efficiency when exactly the *right* type of trap is used for a given application.

That's because both trapping conditions and the characteristics of different types of traps vary widely. There simply isn't any *one* type of trap that will do an efficient job under *all* circumstances. But there is always a particular type of trap best suited for each *specific* set of conditions.

That is why Sarco makes all 5 basically *different* types of traps. In a nutshell, it's to assure you of best trapping results at all times, regardless of requirements.

And don't overlook the very important fact that *only* Sarco makes all these 5 types — not merely variations of one type. Therefore, Sarco can give you absolutely impartial trapping recommendations, backed by 43 years of field experience. Call your local Sarco representative or write:

SARCO COMPANY, INC., Empire State Building, New York, N.Y. Represented in Principal Cities.

2083-C

ONLY SARCO makes all 5 types of traps

—not merely variations of one type!

SARCO SAVES STEAM

HEADWORK

PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH

Air, products for perfect combustion

Required combustion air and products for common combustibles burned with theoretical air requirements

Fuel	For 1 mol of fuel					For 1 cu ft of fuel					For 1 pound of fuel					
	Air		Other products (than N_2)			Air		Other products (than N_2)			Air		Other products (than N_2)			
	O_2	N_2	CO_2	H_2O	S_2O	O_2	N_2	CO_2	H_2O	SO_2	O_2	N_2	CO_2	H_2O	SO_2	
C	1.0	3.76	1.0	–	–	–	–	–	–	–	.0833	.313	.0833	–	–	Mols
	379	1425	379	–	–	–	–	–	–	–	31.6	118.8	31.6	–	–	Cu ft
	32.0	105	44.0	–	–	–	–	–	–	–	2.67	8.78	3.67	–	–	Pounds
H_2*	0.5	1.88	–	1.0	–	.00132	.00496	–	.00264	–	.250	.940	–	0.5	–	Mols
	189.5	712	–	–	–	0.5	1.88	–	–	–	94.8	356	–	–	–	Cu ft
	16.0	25.6	–	18	–	.0422	.139	–	.0475	–	8.0	26.3	–	9.0	–	Pounds
S	1.0	3.76	–	–	1.0	–	–	–	–	–	.0312	.1176	–	–	.0312	Mols
	379	1425	–	–	379	–	–	–	–	–	11.84	44.6	–	–	11.84	Cu ft
	32.0	105	–	–	64	–	–	–	–	–	1.0	3.29	–	–	2.0	Pounds
CO	0.5	1.88	1.0	–	–	.00132	.00496	.00264	–	–	.179	.0672	.0357	–	–	Mols
	189.5	712	379	–	–	0.5	1.88	1.0	–	–	6.77	25.4	13.53	–	–	Cu ft
	16.0	52.6	44.0	–	–	.0422	.139	.116	–	–	.571	1.88	1.57	–	–	Pounds
CH_4	2.0	7.52	1.0	2.0	–	.00528	.0198	.00264	.00528	–	.125	.470	.0625	.125	–	Mols
	758	2850	379	–	–	2.0	7.52	1.0	–	–	47.4	178	23.7	–	–	Cu ft
	64.0	210	44.0	36.0	–	.169	.556	.116	.0950	–	4.0	13.17	2.75	2.25	–	Pounds
C_2H_2	2.5	9.40	2.0	1.0	–	.0066	.0248	.00528	.00264	–	.0962	.362	.0769	.0385	–	Mols
	947	3560	758	–	–	2.5	9.40	2.0	–	–	36.4	137	29.15	–	–	Cu ft
	80.0	263	88.0	18.0	–	.211	.694	.232	.0475	–	3.08	10.13	3.38	.692	–	Pounds
C_2H_4	3.0	11.29	2.0	2.0	–	.00792	.0298	.00528	.00528	–	.1071	.403	.0714	.0714	–	Mols
	1137	4280	758	–	–	3.0	11.29	2.0	–	–	40.6	153	27.1	–	–	Cu ft
	96.0	316	88.0	36.0	–	.253	.834	.232	.0950	–	3.43	11.29	3.14	1.286	–	Pounds
C_2H_6	3.5	13.17	2.0	3.0	–	.00923	.0347	.00528	.0079	–	.1167	.439	.0667	.10	–	Mols
	1326	4990	758	–	–	3.5	13.17	2.0	–	–	44.2	166.3	25.3	–	–	Cu ft
	112.0	369	88.0	54.0	–	.296	.972	.232	.1425	–	3.73	12.29	2.93	1.8	–	Pounds

*Varying assumptions for molecular weight introduce a slight inconsistency in the values of air and combustion products from the burning of hydrogen. True molecular weight of hydrogen is 2.02, but the approximate value of 2 is used in figuring the air and combustion products.

Combustion facts-9:

Handy tables

► HERE ARE two handy combustion tables. The short table is the conventional list of properties and products. The big table is one I computed for POWER some time ago. Keep it handy for special problems.

Note that you enter the big table with moles (sometimes spelled mols) or cubic feet or pounds. Also, you can take out your answers in any of the three units.

For example, you see at once that burning one pound of carbon requires 31.6 cu ft of oxygen and that the air supplying this oxygen will carry in 118.8 cu ft of nitrogen.

Again, you see from this table that burning one cubic foot of methane (CH_4, chief constituent of natural gas) requires 2 cu ft of oxygen, bringing along 7.52 cu ft of nitrogen.

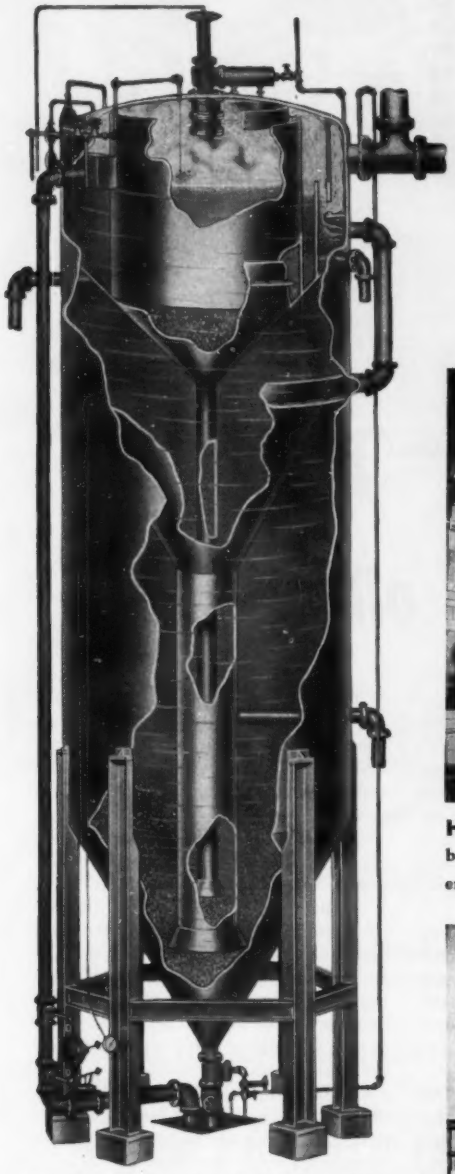
The dry flue gas will contain 7.52 cu ft of nitrogen and one cubic foot of CO_2. The combustion products will also include 0.095 lb of water from hydrogen in fuel, oxygen.

Combustion elements, products

Element or Compound	Formula	Molecular weight	At 14.7 psia, 60 F: Weight, lb per cu ft	At 14.7 psia, 60 F: Volume, cu ft per lb	Nature: Gas or solid	Nature: Combustible	Heat value, Btu: Per pound	Heat value, Btu: Per cu ft at 14.7 psia, 60 F
Carbon	C	12			S	Yes	14093	
Sulphur	S	32			S	Yes	3983	
Hydrogen	H_2	2	.00531	188	G	Yes	61100	325
Carbon monoxide	CO	28	.07385	13.53	G	Yes	4347	322
Methane	CH_4	16	.04233	23.62	G	Yes	23879	1013
Acetylene	C_2H_2	26	.06954	14.38	G	Yes	21500	1449
Ethylene	C_2H_4	28	.07437	13.45	G	Yes	21644	1614
Ethane	C_2H_6	30	.08009	12.49	G	Yes	22320	1792
Oxygen	O_2	32	.08440	11.85	G	No		
Nitrogen	N_2	28	.07421	13.48	G	No		
Air		29 (equiv)	.07636	13.10				
Carbon dioxide	CO_2	44	.1167	8.58	G	No		
Water	H_2O	18						

In Hot Process Softening, too

BELCO Builds a Complete Line-

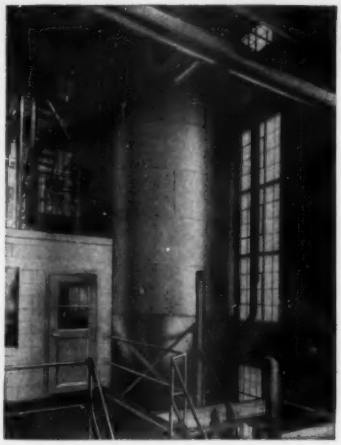


Illustrated literature "Belco In Pictures" is available on request. Write for copy, today.

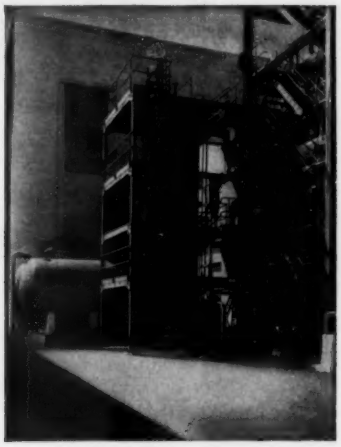
Belco

Processes for Removal of Water Impurities

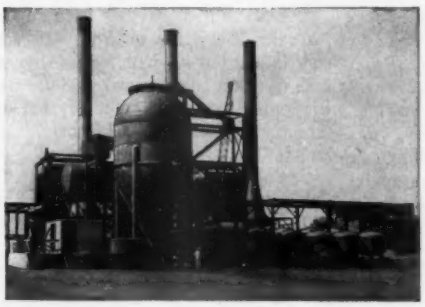
Belco-designed equipment provides high operating efficiency at low operating costs. Many of the country's largest industries rely on Belco for their water conditioning equipment. For example, Belco has built the largest fully automatic demineralization plant in the world and is currently furnishing one of the largest hot lime zeolite installations. A consultation with Belco could lead to lower operating costs for you, too. Write or call for technical assistance at any time.



HOT LIME SODA — Installation in boiler house at large eastern oil refinery. Has capacity of 200,000 lbs/hr.



HOT LIME SODA — Installation in large southwestern utility. One of three units with 90,000 lbs/hr total capacity.



HOT LIME BELCOLITE — Installation at large southern chemical company. Capacity 600,000 lbs/hr. This plant embodies "thoroughfare" operation of separate deaerator and hot process tank. The large hot process tank was designed, built and erected by Belco under its contract with customer.

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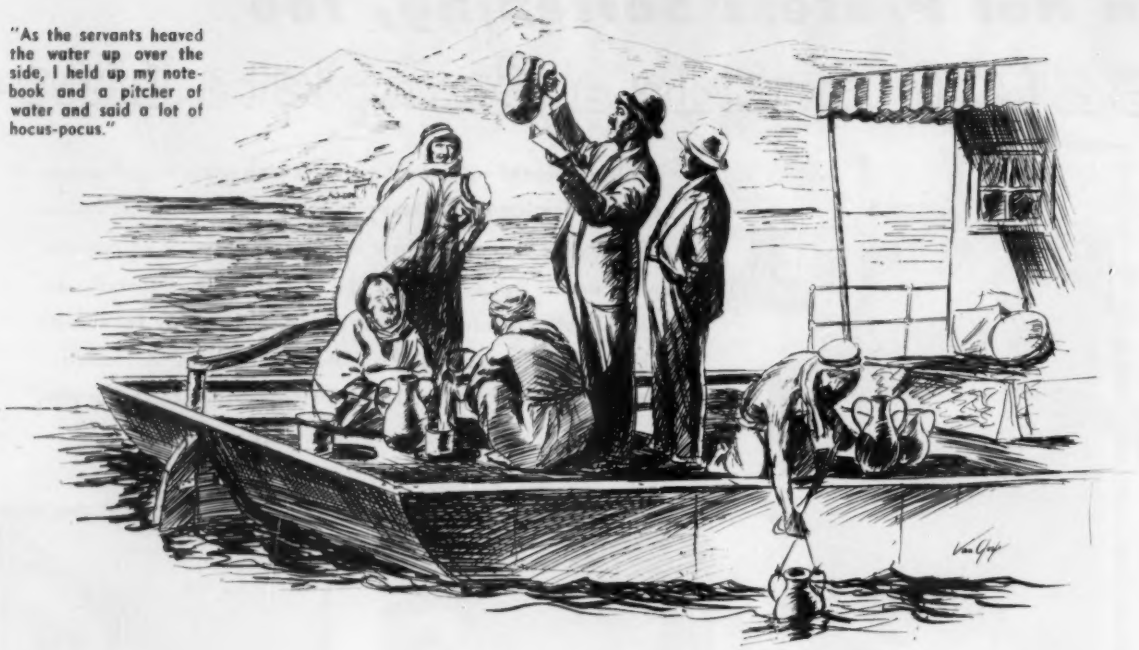


"As the servants heaved the water up over the side, I held up my notebook and a pitcher of water and said a lot of hocus-pocus."

Marmy turns water into oil

► WITH CHRISTMAS just around the corner, orders are piling up for Marmy's shiny red book of stories. No doubt many POWER readers are solving their gift problem the easy way. Some larger orders are possibly to be given away by firms to customers and prospects as good-will builders. While they cost only one dollar (less in large quantities), we'll bet each one is read by many people before being parked on a bookshelf for good.

"Think I'll drop into the Bent Propeller Bar and see if Marmy has anything to say about Christmas gifts for engineers," I said to Lou Rowley, our new chief editor on POWER. When I caught up with the old consulting engineer at his usual place along the bar, he roared, "Bilgewater on gifts. I'll tell you about the time I watered the oil and helped put one of your largest oil firms on the map."

That statement would stop any show, and coming from Marmaduke Surfaceblow at the B P Bar, it did just that. The noisy conversation stopped and all eyes turned on our hero, for he was about to sound off. Marmy ballasted his double bottoms from the bottle before him, then blasted away in his foghorn voice.

"Back in 1927, I was chief engineer on the new diesel tanker *M V Lubright*," he roared. "One trip we shoved off for Bombay with a cargo of crude oil. What made that voyage unusual was the firm's president coming along as a passenger. J Walter Bladenberg was a big man anyway you looked at him. The Captain, Bladenberg and I spent many happy hours on deck that trip sailing to the Far East. I learned he was on his way to visit the Sultan of Sabzwar.

"Several oil firms had been angling for exclusive rights to the Sultan's oil-rich lands, but all had failed. Because making that deal was so important, Bladenberg was giving it his personal attention—after two of his bright boys had failed.

"By the time we hit Bombay, Bladenberg decided to take me with him. There was some rough traveling ahead and he knew he could depend on me to act as his bodyguard. He had me step up my engine-room gang from bottom to top and hire a beachcomber to fill the low spot so our ship had a full crew leaving Bombay.

"In Bombay the two of us booked passage aboard a German passenger ship for Imam-Baba in the Persian Gulf. From there we set out by narrow gage railroad to Mianen, then by car to Maragheh, and finally by camel caravan to a village on Lake Kebzu, the Sultan's summer home up in the mountains.

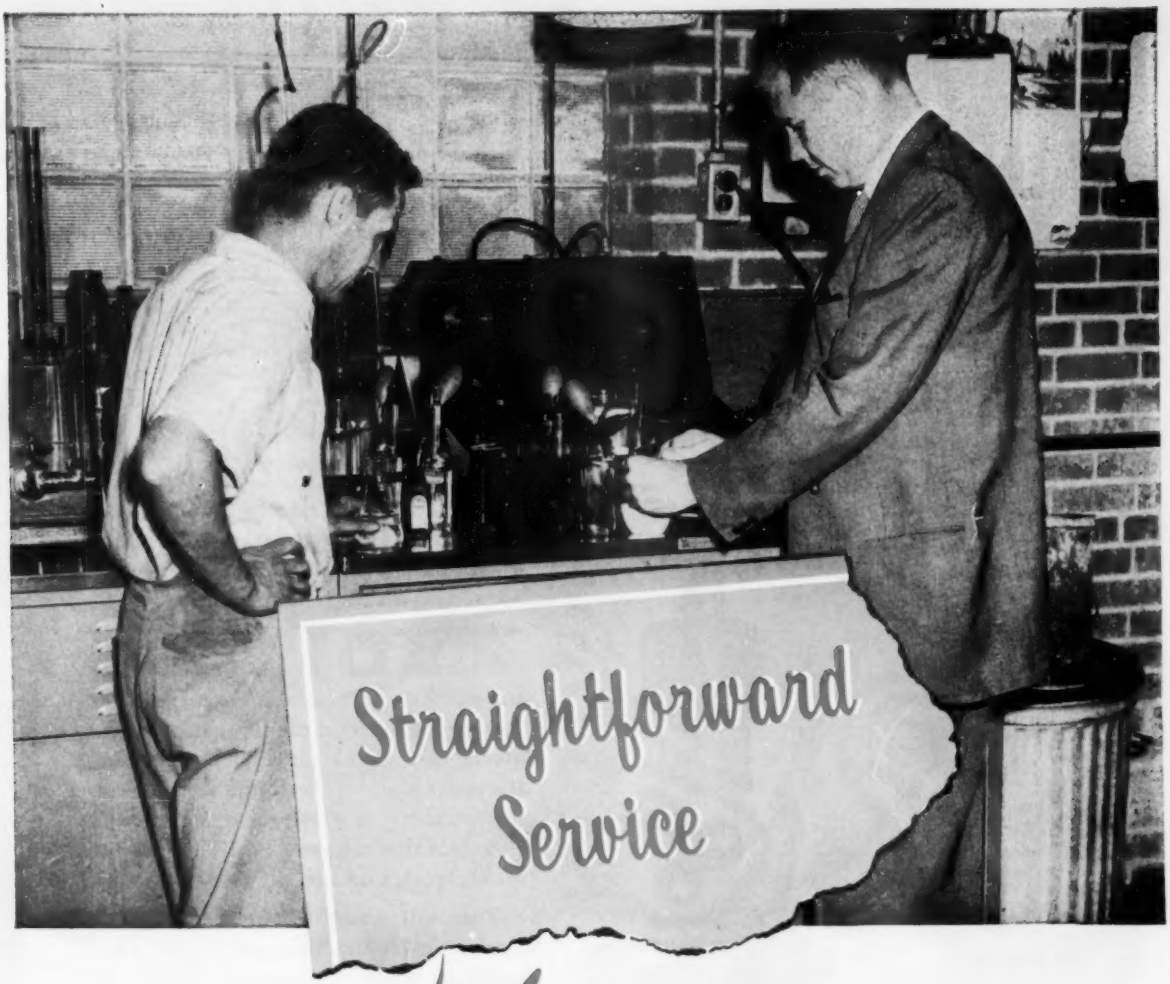
"Our visit had been carefully planned and the Sultan and his friends were on hand to give us the red-carpet treatment. Bladenberg wised me up on dealing with the Sultan beforehand, and it's a good thing he did.

" 'Never talk business until you're ready to leave,' he told me, 'because orientals go in big for entertaining. With them, business appears to be only incidental. We'll probably be wined and dined like royalty for a few days,' he guessed. 'That means eating and drinking until it comes out of our ears. But don't let them out-eat or out-drink us or they'll think we don't appreciate their hospitality and be offended.'

" 'Don't worry about me not taking on enough dry or liquid fuel,' I assured him. 'I'll stow away as much as any of them and I won't even have a list.'

"The Sultan's summer home looked like a young palace. Its elevation was about 6000-ft and it faced on Lake Kebzu. The first evening the Sultan threw a banquet for us that topped any nose-bag party I ever horned in on—and I've been to plenty. There were about 50 guests and five goats had been butchered and barbecued for us. A gang of servants, acting as a bucket brigade, supplied a low grade of native drain cleaner for washing down the high-powered fuel.

(*Continued on page* 192)



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A paper on "A Laboratory Method for the Study of Steam Condensate Corrosion Inhibitors," presented at the 8th Annual Conference, National Association of Corrosion Engineers, has been reprinted by Nalco for distribution to men interested in this problem. Your copy will be sent free upon request.

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can be planned for lasting economy

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A variety of patterns for 125-150-200-300 and 350 lb. service, including Underwriters' Approved valves, also Solder End, Socket End, and Quick-opening Gates.

SPLIT WEDGE

Union bonnet, traveling spindle patterns for 125 and 150 lb. service. Also the popular SWINGTITE fast-action Lever Gate.

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For long-range economy in destructive services, the Jenkins line includes the 200 and 300 lb. valves illustrated (right). Available with MONEL rings and bronze wedge, or MONEL rings and nickel alloy wedge for exceptionally severe conditions.

JENKINS BRONZE GATES WITH MONEL SEAT RINGS

BRONZE WEDGE

200 lb.	300 lb.
Fig. 270-U	Fig. 280-U
Fig. 270-UL	
(U.L. approved for L.P.G. service)	

NICKEL ALLOY WEDGE

200 lb.	300 lb.
Fig. 270-UN	Fig. 280-UN

Look over the list of 40 patterns in Jenkins complete line of Bronze Gates. You'll find the valve you need, and you can be sure it is built to provide the *extra value* that makes Jenkins the best buy for any service.

This new folder includes a handy chart for quick reference, and describes many features of the most popular patterns that assure easy maintenance and long wear. It's convincing evidence that the Jenkins line includes "a valve for every service" — valves that take top-rating in any test for endurance and economy.

You will want this up-to-date information on Jenkins Bronze Gates. Use the folder to plan your hookups for lasting economy.

GET THIS NEW BRONZE GATE FOLDER from your Jenkins Valve Distributor or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Form 181-C.

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SOLID WEDGE
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SOLID WEDGE
SCREW-IN BONNET
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UNION BONNET
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Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

Turbine-generator buying has been slow – the sparsely filled 1956–57 order boards tell the story. To an industry that has struggled for six years to build production capacity to meet surging demand, and will reach a record 15-million-kw output this year, lag in new business looked disturbingly like a return to the "feast or famine" experiences of the past.

The builders know their prime customers, the utilities, have pulled reserve margins back to "safe" levels and, for the first time since the war, can take a "breather." They know, too, that most long-range forecasts show need to double capacity in 10 years. So they have done their best to keep the "pause" short, to sell the delivery and price advantages of units ordered today. And it looks as if the tide is turning – both GE and Westinghouse report an encouraging upturn, expect to see those order boards take on a healthier glow.

Seagoing gas looks like a possible development of the scheme for compressing and chilling natural gas to –258 F, for bulk shipment (SP, July). The British are looking into the process for tanker haul of cheap gas from the Middle East, where there's little demand, to fuel-hungry England.

Salt-water makeup will be used at PG&E's new Morro Bay plant, probably the first industrial application of ocean-water distillation in the U.S. Two fresh-water wells will be on tap, but main supply will come from two sea-water evaporators, each capable of supplying 50 gpm of distilled water. First of Morro Bay's 150,000-kw units goes into service next year, second is slated for 1956. Plant design is being carried forward by Pacific Gas & Electric and Bechtel Corp.

Los Angeles, as any resident will tell you, grows faster than anything. A more objective indication of growth comes from the LA Dept of Water and Power: steam-power generation, which now tops hydro, passed the 10-million-kwhr-per-day mark back on Oct 1, just after the first unit of the department's big new plant in the San Fernando valley went into service.

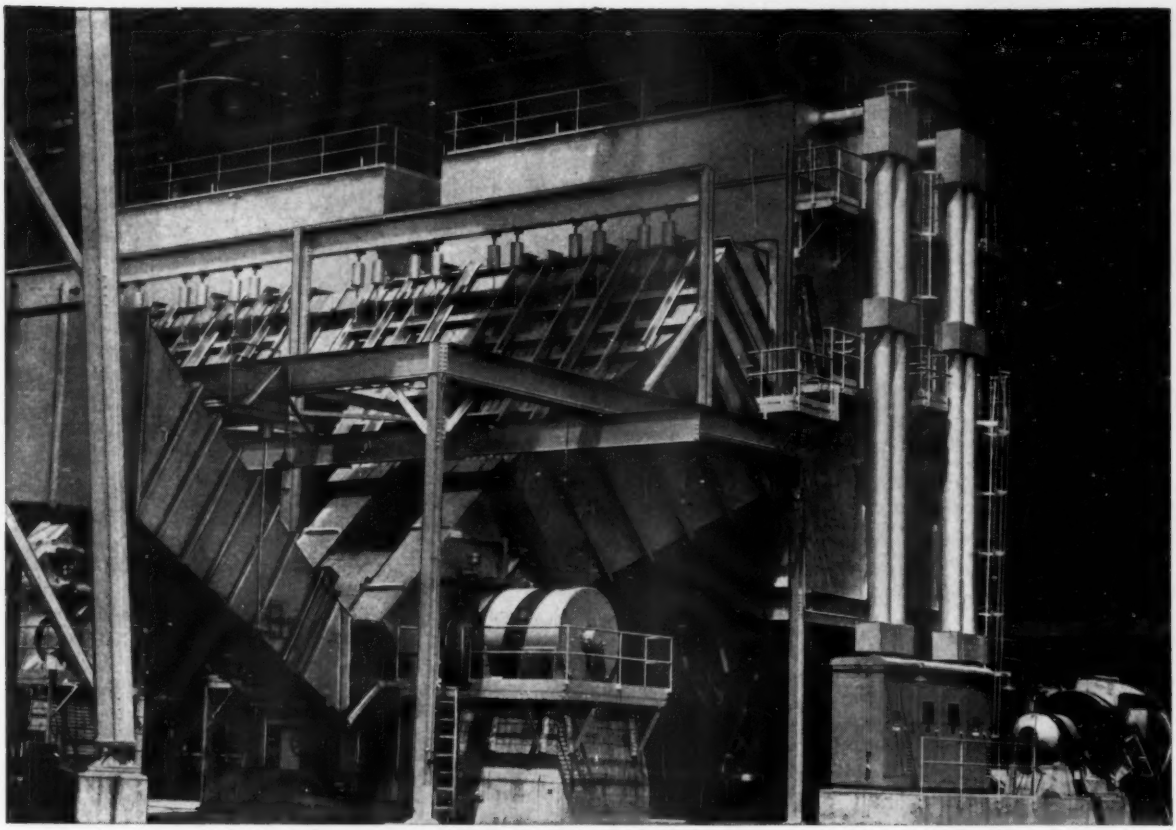
Natural gas keeps pushing ahead in the competitive fuels picture. In the first four months of this year, gas consumption by electric utilities was up 18% over the start of last year, while oil use was down by 15% in the same months.

Free-piston engines will have a chance to show their stuff in the Maritime Administration's experimental program for modernizing Liberty ships. In addition to the two moth-balled Libertys that will get steam- and gas-turbine installations (SP, Oct), a third will get a free-piston plant.

General Motors (reported to have an option on a license from SIGMA, French builders of these units) has contracted to develop a seagoing design. Free-piston engines have previously been built in the U.S. by Cooper-Bessemer and Lima-Hamilton (Power, May 1953, pp 82–85).

Atoms in New England – that's the plan of 11 of the area's electric utilities. As Yankee Atomic Electric Co, they propose to dig right into construction details of a nuclear power plant, as soon as the Atomic Energy Commission OK's use of fissionable materials. Current guesses put the plant in Massachusetts.

Lou Lowley



For this Midwest power station, Westinghouse induced draft (center) and forced draft (right) fans move a total of 92,500,000 cubic feet of air and gas every hour, every day.

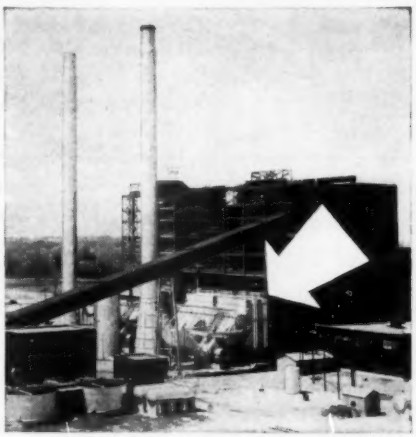
8 All-Weather Westinghouse Fans Supply Mechanical Draft to Meramec Station of Union Electric

Air-cooled bearings, welded steel construction resist elements

Eight Westinghouse Turbovane mechanical draft fans with vane control supply draft to the two boilers of the Meramec Station of Union Electric Company located in St. Louis, Mo. Installed outdoors where they are exposed to the varying elements, these fans perform their part of a vital power-generating job with only routine maintenance.

Four of these fans are Turbovane forced-draft type arranged double width, double inlet. The other four are Turbovane induced-draft fans with radial-tipped blades and erosion-resistant wheels. Vane control on all fans allows instantaneous regulation of air volumes to meet changing steam demands.

For power generation—or for any other air handling job—check on Westinghouse-Sturtevant apparatus today. Let the industry's most complete air handling line *put air to work* for you—efficiently, economically. Call the Westinghouse-Sturtevant specialists located in your area or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.



Located at the heart of power generation at Meramec, four Westinghouse forced draft fans supply 150,000 cfm each, at 11.3 inches water gauge while operating at 1180 rpm. These are teamed with four Westinghouse induced draft fans handling 235,500 cfm each, at 277°F and 17.1 inches water gauge while operating at 700 rpm.

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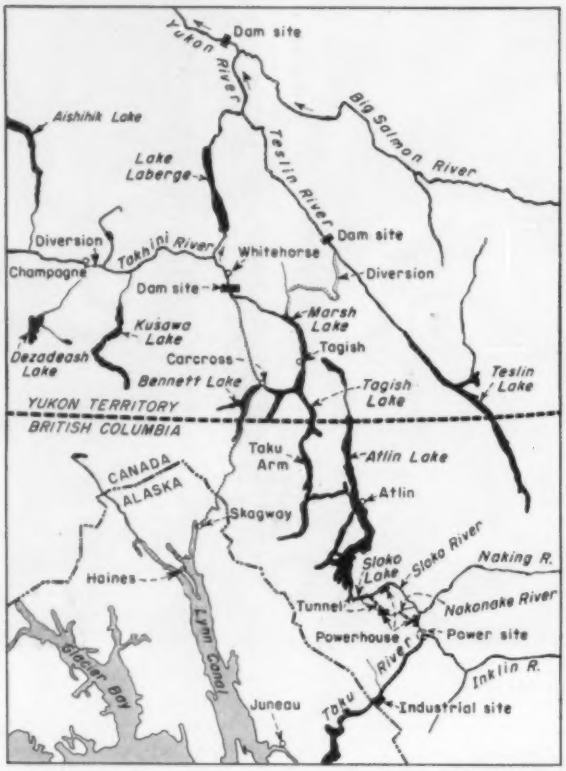


REVERSED waterflow of Upper Yukon, tunneled to Pacific side of mountains will provide 2192 ft head for power generation

World's largest hydro projects to generate 5,000,000 hp for Northwest Canada

► POWER-GENERATING and metal-refining projects planned for Northern British Columbia and the Yukon Territory in Canada promise to be the world's largest. Quebec Metallurgical Industries Ltd and Frobisher Ltd, a subsidiary of Ventures Ltd, will build the developments.

Head waters of the Yukon River are in several lakes (see map) from which it flows 2000 miles north, then west, through Alaska into the Bering Sea. A dam near Whitehorse will raise the lakes' level to turn the river's flow south through tunnels into Taku River and the Pacific Ocean, near Juneau, Alaska. A storage reservoir formed by the lakes, with a maximum elevation of 2192 ft, will provide 28,000 cfs regulated flow to generate 4,300,000 hp.

A one-mile tunnel will connect Atlin with Sloko Lake to the south. A second tunnel, 9.7 miles long, will run through the mountains from Sloko Lake to Nakonake River to provide 1100-ft head and generate 2,800,000 hp. In a latter development a third tunnel will be driven between Nakonake and Taku Rivers to generate 1,500,000 hp. These developments, with other sites on the Yukon and Inklin Rivers can generate over 5,000,000 hp.

Industrial part of the project will be developed on the Taku River in British Columbia, just east of the Canadian-Alaskan border. Included will be smelters and refineries to treat ores and concentrates shipped from distant parts of the world and Pacific areas of Canada.

First stage of the project is scheduled for completion in 1962 when 888,000 hp will be developed. Cost of the initial stage will be $212,000,000. Plans call for 24,000 hp to be in operation by 1956 to provide construction power.

Forecast increasing supply of copper for industry

► "ENGINEERS AND DESIGNERS may specify copper for new products with the assurance that copper supplies will keep pace with an expanding market," according to Wm A Meissner, Jr, Deputy Director, Copper Div, Business and Defense Services Administration, Dept of Commerce. Speaking at a meeting in New York sponsored by the Copper and Brass Research Association, he said that copper will be available in ever-increasing quantities.

The widely-held attitude that the supply of copper is insufficient for our needs in times of emergency, and that copper reserves will peter out at some future date are erroneous, according to a spokesman for the association. He declared that as mining techniques improve, as new geophysical methods of exploration are developed, as advances are made in power and transportation, lower grades of ore become available. These add to our resources, and multiply them.

In addition, the spokesman said, copper is virtually indestructible, and for every five lbs entering the economy in the form of products today, roughly three lbs will be returned as scrap in the future. This metal is also part of the nation's "copper capital" and is a dependable source of future supplies.

The association believes that any substitution for copper that aids the manufacturer of a product, or profits the consumer, is desirable. But substitution based on the unwarranted assumption that a material will not be available is dangerous, and often costly in the long run, it was declared.

For coming events see page 234

Gas-insulated transformers developed by General Electric

► FUTURE TRANSFORMERS may be lighter, quieter and safer as a result of a development that may eliminate liquids as power transformer insulations and coolants, according to W S Ginn, general manager of General Electric Co's power transformer department.

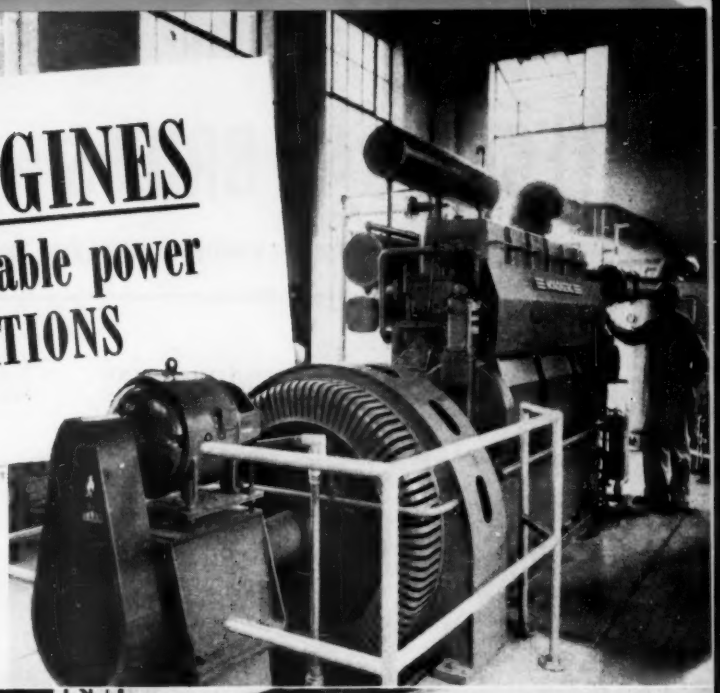
The development, a joint project with Consolidated Edison Co, New York, involves the first application of a high-dielectric gaseous insulation to high voltage power transformers. The new dry-type units filled with sulphur hexafluoride gas will be suitable for both indoor and outdoor installation. They are expected to eventually displace oil- and askarel-filled transformers.

Two units, rated 2000 kva, 69 kv, are on General Electric's drawing boards.

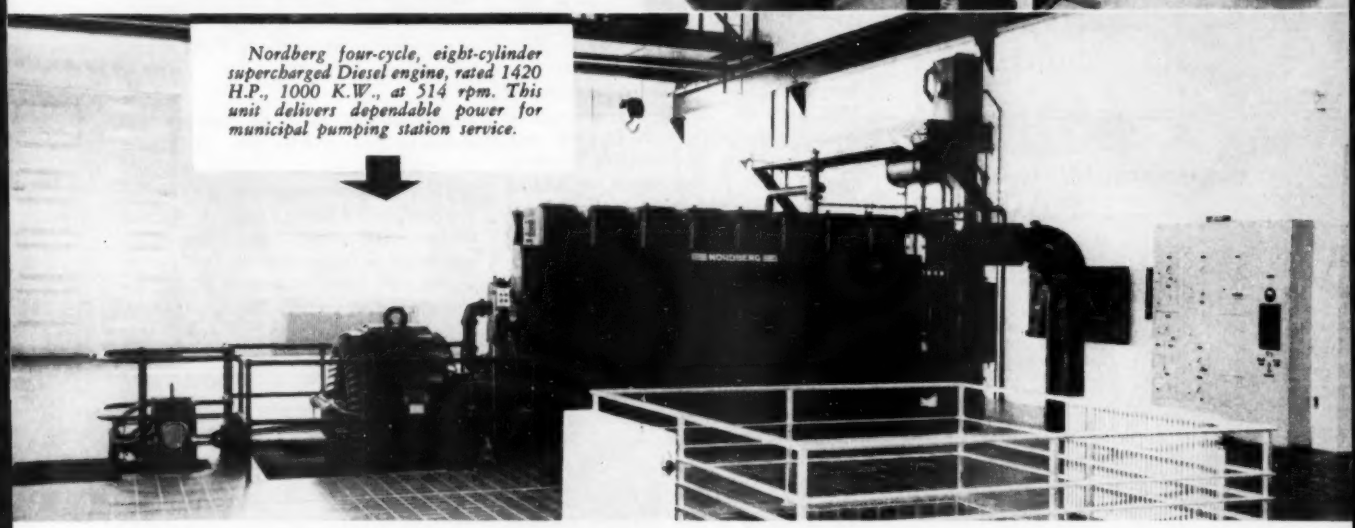
(Continued on page 228)

NORDBERG ENGINES

furnish low cost, dependable power for PUMPING STATIONS



Nordberg four-cycle, six-cylinder Duafuel® engine rated 375 H.P., 250 K.W., at 600 rpm. This unit, operating on natural gas, powers two motor-driven centrifugal water pumps.



Nordberg four-cycle, eight-cylinder supercharged Diesel engine, rated 1420 H.P., 1000 K.W., at 514 rpm. This unit delivers dependable power for municipal pumping station service.

WHEN it comes to furnishing reliable, low cost power for municipal and industrial pumping operations, Nordberg engines have been thoroughly job-tested and proved in numerous installations in many parts of the world. Two typical Nordberg Diesel Engine Generator units are shown here, each providing the necessary power to keep electrically-driven water pumps on the job, day-in, day-out.

Built to provide the most economical power plant with low first cost as well as low operating costs, Nordberg engines will efficiently burn Diesel fuel, natural gas, or any combination of both—as well as sewage gas, manufactured gas and propane. With this wide fuel selection Nordberg can furnish the most efficient unit to meet specific power requirements . . . for pumping applications and for main or stand-by-power in almost every class of service.

Nordberg, as builders of America's largest line of heavy duty engines, in sizes from 10 to over 10,000 H.P., backed by over a half century of specialized machinery building experience, can give you valuable assistance in solving *your* particular power problem. Call or write for further information. *Nordberg Mfg. Co., Milwaukee, Wis.*

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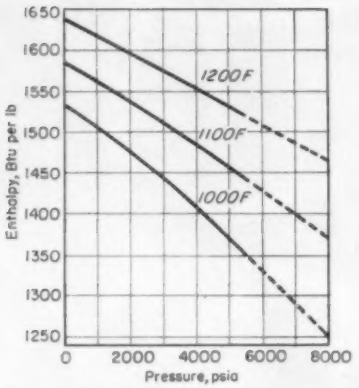
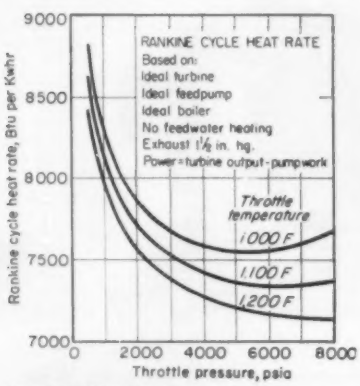
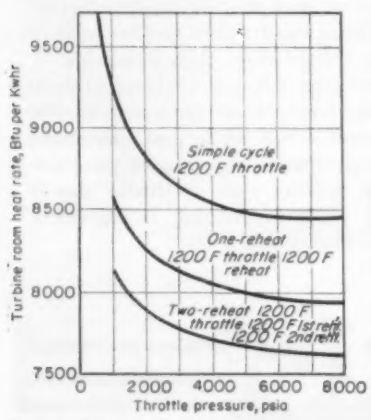


EXTRAPOLATED physical values for steam



HEAT RATES: Rankine cycle performance



SIMPLE-CYCLE turbine-room heat rates

Thermodynamics of supercritical pressure steam power plants. *By Jerome Bartels, Brooklyn Polytechnic Institute.*

This paper attempts to stake out boundaries and to survey the level of efficiencies attainable in the area of supercritical-pressure plant design. It points out the basic thermodynamic advantage of using water at supercritical pressures in cycles having high throttle temperatures.

Turbine-room heat rates of the Rankine cycle and the simple cycle are determined for throttle temperatures of 1000, 1100 and 1200 F over a range of throttle pressures from 0 to 8000 psia. For a constant turbine-inlet temperature of 1200 F, the effects of adding one and two reheaters are measured over a throttle pressure range of 0 to 8000 psia with nonextraction operation. Location of extraction points for feed heating is discussed, and a particular cycle analyzed.

A helpful tabulation gives data on cycle performance for designs encompassing various throttle pressures, temperatures, number of steam reheats, and number of stages of feedwater heating. *ASME paper No. 54-F-37.*

The influence of the peculiar features of tropical and subtropical regions on the design of thermal power plants. *By W K Carruthers.*

Limiting its discussion to the Caribbean and Central America, this study is nevertheless extremely interesting to American designers. It raises a number of points of value to anyone concerned with thermal plants in these areas.

Higher ambient and wet-bulb temperatures, more annual precipitation and higher rainfall rates require good plant design. This includes need for excellent ventilation, uncrowded placement of equipment, liberal plans for surface drainage of plant areas, and as few below-ground-level pits as possible.

Allowable wind loads on structures usually need not be reduced; prevailing winds are found useful in aiding natural ventilation.

Water supply can be awkward and difficult, but means do exist for overcoming, for the most part, problems that arise.

Due to sharp evening load peaks, characteristic of the tropics, the general tendency is to retain generating units that under ordinary circumstances might be obsolete. They permit relatively cheap peak capacity to be realized. More than ordinary attention to station service supply and plant auxiliaries is warranted if a high standard of service is to be attained. *WPC paper; no number.*

Forced outage rates of high-pressure steam turbines and boilers. *AIEE joint subcommittee on probability methods.*

This, a continuation of an earlier study of forced outage data, is confined to horizontal steam turbine-generators operating at pressures of 700 psi or higher and rated at or over 20,000 kw condensing or 10,000 kw superposed. It is also limited to boilers with a continuous rated capacity of 200,000 lb per hr or more and with outlet pressures of 700 psi or greater.

The availability factor of turbines covered by this report is 92.61%, which is the sum of the percentage for unit-days available but not operated (1.38%) and the percentage of unit-days operated (91.23%), both of which are expressed as a percentage of total unit-days installed. The availability factor for boilers on the same basis is 90.90%. *AIEE paper No. 54-320.*

Gas turbines

Gas turbine power plant testing. *By T D McKone and R L Hendrickson, General Electric Co.*

This paper describes methods currently in use by the authors' company for evaluating over-all performance of commercial gas-turbine power plants by factory tests before shipment. Details of instrumentation and sample test results are included. A system for correcting test performance to contract or guarantee conditions is suggested.

As gas-turbine power plants grow in size and cycles become more complex,

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factory testing probably will be impractical. It may become necessary for the manufacturer to guarantee performance over a wider range of operating conditions, or supply approximate corrections to guaranteed performance for comparison with actual conditions at final installation. *ASME paper No. 54-F-35.*

Acceptance and operational tests of a 4250-hp coal-burning gas turbine. Part I—preliminary oil-fired operation. Part II—coal-fired operation. *By J I Yellott, P R Broadley and W M Meyer, Bituminous Coal Research, Inc.*

The Locomotive Development Committee of Bituminous Coal Research, Inc, has run more than 1500 hours of acceptance and operational tests on a 4250-hp Allis-Chalmers gas-turbine power plant. The first of these two papers presents results of the oil-fired acceptance test in which turbine shaft output at contract conditions was found to be 4257 hp, or 13.5% above warranted 3750 hp.

The second paper describes two coal-burning operational tests. A total of 178 hours of part-load operation on coal, with oil pilot flames in the combustors, resulted in negligible blade erosion and complete absence of ash deposits. Then 750 hours of high-load high-temperature operation were run on coal alone. During this period 1066 tons of high-volatile bituminous coal were burned, generating 2,070,750 hp hr at an average specific fuel rate of 1.03 lb per hp hr.

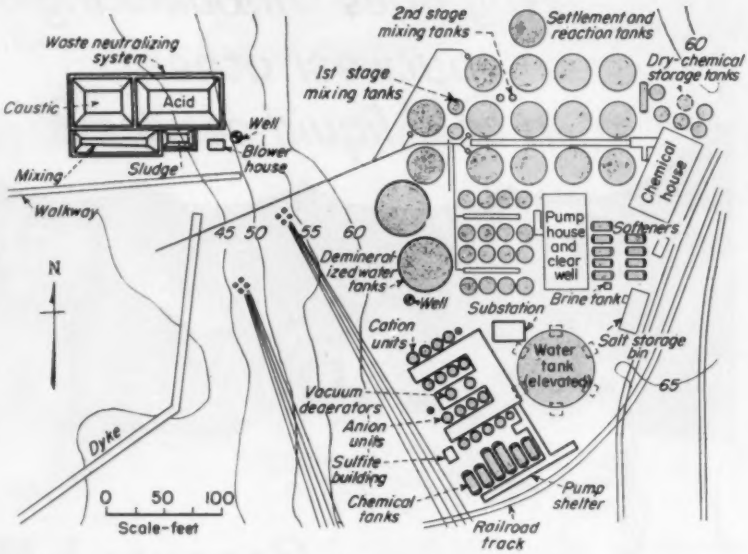
Inspection of the turbine after the 750-hr test showed that ash-separator malfunctioning had caused excessive turbine-blade erosion. A new multi-tube separator has been installed and the plant returned to service. Preliminary test data are given for the new unit. *ASME paper Nos. 54-F-39 and 54-F-40.*

British developments in gas turbines. *By Sir H R Cox, A T Bowden, R J Welsh and Prof W R Hawthorne.*

This paper briefly describes the early history of British gas turbines and discusses recent developments in land, marine and aircraft units.

Thirteen British firms are making gas turbines today for land use. Units range in size from 50 hp to 20,000 kw. Gas turbines of 900 kw have been standardized by one company. Other firms have standard 2000/2500-kw units. *WPC paper; no number.*

Directions for ordering papers on p 226



PLAN of water-treating area at Louisiana station, showing new and existing units

How demineralization pays off in central-station plants serving loads in two widely separated areas in the U. S.

Gulf States Utilities Company demineralizes 40-million lb per day boiler feedwater for 1500-psi boilers—water-plant design. *By C R Stewart, Stone & Webster Engineering Corp.*

This new demineralizing plant of 3500-gpm net capacity is the latest of a number of history-making steps at the Louisiana station. While the new plant by itself is a complete unit, there are several instances in which advantage was taken of conditions associated with the older plant. The complete water-treating area can now produce over 4-million lb-per-hr of boiler feedwater.

The demineralized, or condensate-quality, part of this total is fed to the new 1500-psi boilers. Steam exhausted from all the turbines of this new part of the station goes to neighboring industries at 135 psi.

Both the high quality of feedwater required and the unusual type of well water to be treated led to thorough exploration of several treatment methods. Major changes resulting from pilot-plant operation of selected demineralizing equipment included provision for use of larger quantities and higher concentrations of regenerant chemicals, heating of anion regenerant solutions, reclaiming and reuse of substantial portions of the regenerant chemicals.

The further necessity of operation of the new plant with a minimum of manual labor, as well as the very critical water quality, led to a plant design that includes exceptionally complete instrumentation and automatic controls. *APC paper; no number.*

Automatic mixed-bed demineralizing at the Albany steam station. *By Thomas Finnegan, Niagara Mohawk Power Corp and Durando Miller, The Permutit Co.*

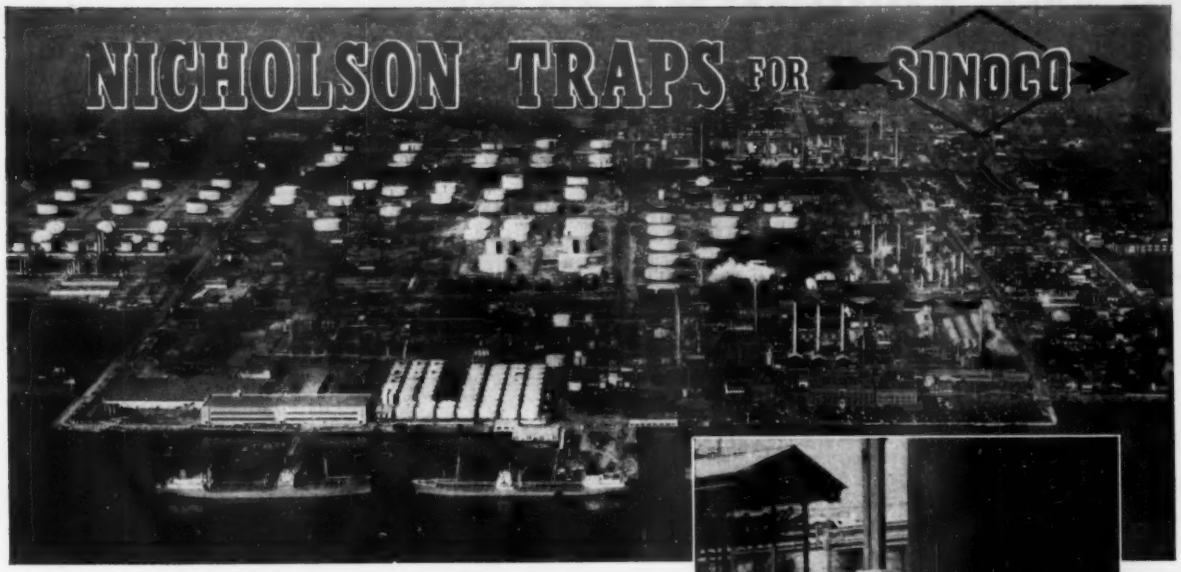
Makeup for the Albany steam station is prepared by an automatically regenerated mixed-bed demineralizer. Station has four 100,000-kw units operating on 1450-psig 1000-F steam with reheat to 1000 F at 415 psia at full load.

Considerable capital expense was saved by use of the demineralizer. Cost of demineralized makeup is expected to be less than that produced by an evaporator. Analysis showed a 2 Btu saving in favor of demineralizing. Greater chemical cost for demineralizing cuts the cost difference of the systems.

Since the plant has gone into opera-

(Continued on page 222)

NICHOLSON TRAPS FOR SUNOCO



Air view of Sun Oil Company's refinery at Marcus Hook, Penna.

Nicholson steam traps are shown above installed on storage tanks requiring heating at Sun Oil Company's Marcus Hook, Pa., refinery. Sun has standardized on this type of installation.

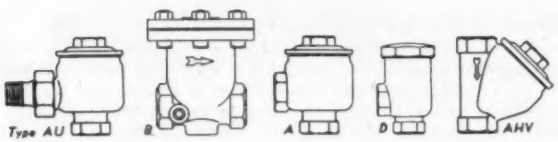
Standard for

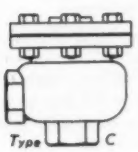
OUTDOOR USE

Due to

FREEZE-PROOF

Feature





SIX TYPES FOR PROCESS, HEAT AND POWER -- Construction of bronze, semisteel or cast steel. In sizes of ¼" to 2" for pressures to 300 lbs. All six types of traps have stainless steel valves and seats. Bellows are furnished in bronze, monel or stainless steel.

Send for TRAP CATALOG

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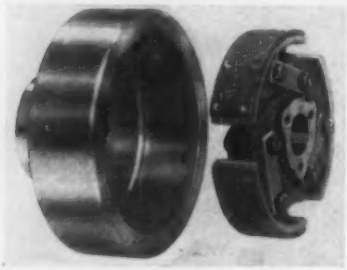
Sales & Engineering Offices in 58 Key Cities

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers

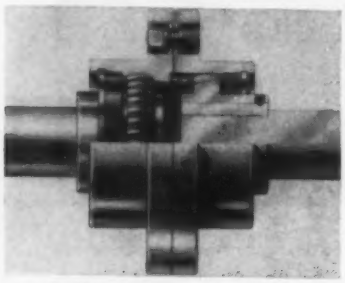
Three new coupling units for mechanical drives . . .



Automatic clutch couplings

1100 • Improves starting conditions and provides smooth acceleration on drives for high inertia equipment. Prevents torsional resonance on internal combustion engine drives. Full details in bulletin CE-3.

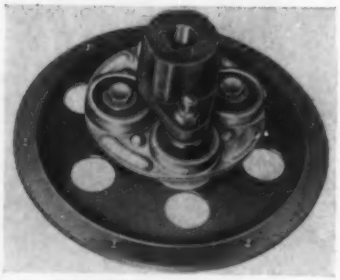
Hilliard Corp, Elmira, N. Y.



Splined-sleeve couplings

1101 • Male teeth of each coupling half are cut on a spherical arc while internal teeth are cut with a straight root. Thus, whenever misalignment occurs, curved tooth maintains constant area of contact with internal tooth. Bulletin C-540.

Philadelphia Gear Works
Erie Ave & G St, Philadelphia 34, Pa.



Flexible coupling units

1102 • *Morflex* coupling units attach to flywheels of industrial engines; are adaptable to industrial engine drives requiring a long-life, torsionally flexible, shock-resistant, weatherproof coupling for flywheel-to-driveshaft connection.

Morse Chain Co, 7601 Central Ave, Detroit 10, Michigan

Conveyor pulley has interchangeable split tapered hubs

1103 • Heavy-duty steel conveyor pulley features interchangeable split tapered hubs, claimed to reduce maintenance, speed assembly and increase life of installation. When drawn into pulley end-disk hub squeezes its shaft with a clamp-grip. This eliminates possibility of pulleys "walking" on their shafts. Units available as standard in crown or straight face, sizes 6 through 60-in. diameter, 12 through 63-in. face, and for shafts through 10-in. diameters.

The American Pulley Co, 4200 Wissahickon Ave, Philadelphia 29, Pa.

Vibratory feeder has capacity of 750 tons per hr

1104 • Heavy-duty feeder utilizes patented *Syntron* electromagnetic principle that eliminates such rotating parts as gears, belts, idlers, eccentrics, etc, and produces 3600 conveying vibrations per min. from 220 or 440 v, 60 cycle, ac. Unit is equipped with 54x72-in. flat pan trough and has maximum feeding capacity of 750 tons per hr of bulk materials. Full details in manufacturer's bulletin F-86.

Syntron Company, Lexington Ave, Homer City, Pennsylvania

Motor base permits easy adjustment of center distances

1105 • *Quick-Slide* motor base is designed for quicker and easier center distance adjustment, needed for belt stretch and change in pitch diameter of variable-pitch sheave. Unit features provision for releasing adjusting screw, which permits motor to be moved freely after base is bolted down. Further details in bulletin 497.

T B Wood's Sons Company, Chambersburg, Pennsylvania

High-voltage starters for 2200 to 5000-volt motors

1106 • Starters for 2200 to 5000-v squirrel-cage, wound-rotor and synchronous motors are built in three styles: 50,000 kva interrupting capacity; with power fuses for systems of 150,000 kva and 250,000 kva availability; and in the *Valimitor* style in which air-core reactors limit infinite kva to a finite value within rating of the starter. Full details of these units available from manufacturer.

The Electric Controller & Mfg Co, 2700 E 79th St, Cleveland, Ohio

Acid-resisting packing for temperatures to 400 F

1107 • Sheet packing, *R/M No. 1307*, is made of white asbestos fibres completely impregnated and coated with an acid-resisting compound. Manufacturer claims gaskets cut from this material have higher tensile strength and better flexibility than those made from sheets using blue asbestos fibres. Product is recommended for use against sulphuric, nitric and other acids in various concentrations where tight seal in flanges is necessary, and for temperatures to 400 F.

Raybestos-Manhattan, Inc, Packing Div, Manheim, Pennsylvania

Pipe strainers for applications at pressures to 250 lbs

1108 • Cast semi-steel Y-pipe strainers are designed for use in steam, air, water, oil and gas lines at pressures to 250 lbs. Available in eight sizes from ¼ through 2-in. A copper-asbestos gasket positioned between base of bushing and the body, eliminates possibility of gasket blowout, according to manufacturer.

Armstrong Machine Works, Three Rivers, Michigan

Aerosol and smoke photometer for air pollution control

1109 • Portable forward-scattering aerosol and smoke photometer is designed for study, measurement and control of air pollution and particulate matter suspended in aerosols. Other applications include testing efficiency of fans, air-wash systems and air conditioners. Instrument features extreme sensitivity by measuring forward-scattering at small angles that may be 100 to 10,000 times greater than scattering in all other directions. Complete details from manufacturer.

Phoenix Precision Instrument Co, 3803 N 15th St, Philadelphia 40, Pa.

Pipe surface thermometers for temperatures to 370 F

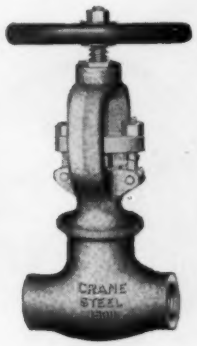
1111 • Pipe surface thermometers may be used to obtain temperature of pipes and tubes from ½ to 2-in. size. Unit is fastened to pipe by a spring clip without use of tools. Temperature sensitive element is calibrated bimetal and is closely coupled thermodynamically to pipe. Accuracy is ± 2 deg over entire range of thermometer, which reaches stability within five minutes. Available in two ranges, one from –50 to 250 F, the other from 70 to 370 F.

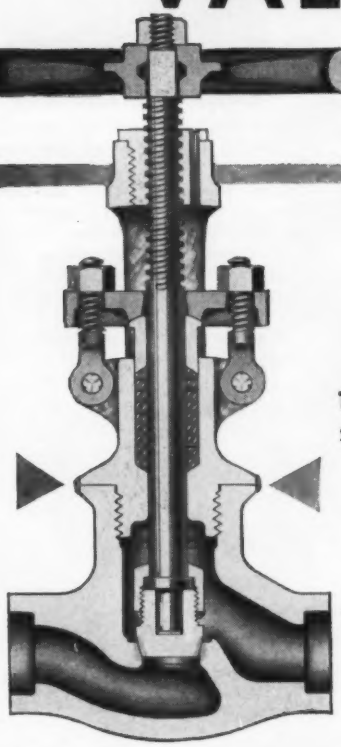
Pacific Transducer Corp, 11836 W Pico Blvd, Los Angeles 64, Calif.

For more data on these items, use post cards p 169. Identify request with item numbers

newest in small steel valves for high-pressure/high-temperature

CRANE
lip-seal bonnet (patented)
VALVES





Lip Seal design is exceedingly simple. Body and bonnet are screwed together until a firm metal-to-metal contact is made between the smoothly machined flat surface on the shoulder of the bonnet and the top of the body. The small lips around the periphery are then seal welded.

- **Absolute Bonnet-Joint Tightness**
- **Freedom from Bonnet-Joint Maintenance**
- **Minimum Weight and Bulk**
- **Easier Dismantling and Reassembly**

1500 AND 2500-POUND GLOBE AND ANGLE PATTERNS
SOCKET-WELDING AND SCREWED ENDS. SIZES ½ TO 2-INCH

What better way to seal against leakage at the bonnet joint of a small steel valve . . . than with a simple weld. And that's all the weld is ever called upon to do. Extra-long body-bonnet threads carry all mechanical loads—and at comparatively low stresses. Should dismantling be necessary, the seal weld may be repeatedly ground off—and reapplied—without damage to valve.

Right along with this modern Crane sealing principle go other important refinements. You get a compact, weight-saving structure without sacrificing strength or reducing seat area—a more rigid swivel disc-stem connection—durable Stellite-faced plug-type disc—and Stellite-faced integral seat.

Crane Lip-Seal Bonnet Valves are by far your best buy for high-pressure/high-temperature power services . . . worthy companions to the larger Crane Pressure-Seal Valves. Ask your Crane Representative for Circular AD1902, or write direct.

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CRANE VALVES

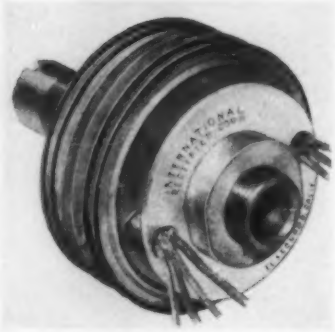
CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 160

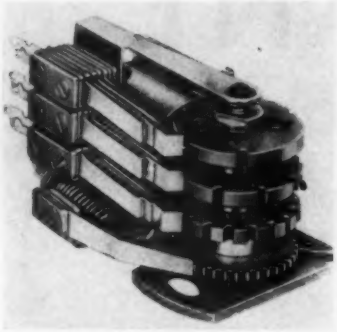
Electrical products—9 recent developments for varied applications



Rotating selenium rectifier

1180 • To eliminate disadvantages of commutator and slip rings in dc generators, unit is mounted on same shaft with alternator field and ac exciter. This eliminates usual slip rings. External dc supply feeds the exciter field. Exciter output is fed to ac terminals of rectifier. Output from rectifier is connected directly to alternator field windings. Use of an ac exciter eliminates commutator.

International Rectifier Corp, 1521 E Grand Ave, El Segundo, Calif.



Cam-type rotary relay

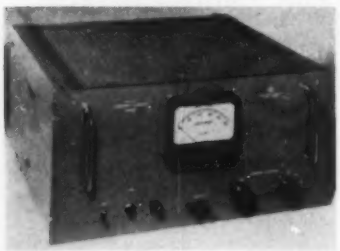
1131 • Single cam-type rotary relay can be used to replace whole banks of relays or combinations of relay and stepping switches. Manufacturer claims other features to be compactness, lightness, and resistance to shock, vibration and temperature changes. Unit, measuring 3¼ x 2 7/16 x 1 25/32-in., can be used for cam switching, alternate on-off operations and stepping operations. Full details on request.

Automatic Electric Sales Corp, 1033 W Van Buren St, Chicago, Ill.

Temperature controller

1130 • Small, compact unit is designed for accurate indicating and instantaneous control in the process industries. Both temperature measuring system and control chassis are plug-in design to permit quick removal for servicing without disturbing the instrument or external wiring. Balancing adjustment for tuning alignment index and indicating pointer is front accessible. Write for bulletin F 5358-1.

Wheelco Instruments Division, Barber-Colman Co, Rockford, Ill.



Constant-current power supply

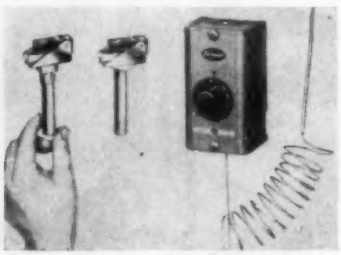
1129 • Constant current dc power supply, *Model CC-503-B* is designed to operate in temperatures from −50 to +130 F. Output current ranges from 0 to 500 ma in five steps with vernier control of 100 ma between steps. Voltage across load may vary from 100 to 250 v, depending on load resistance. Full details on request.

Dressen-Barnes Corporation, 250 N Vinedo Ave, Pasadena, Calif.

Corona testing equipment

1127 • Units are designed to facilitate nondestructive testing of insulation in electrical equipment. Testing is accomplished by detection of electric discharges that may result when ac test voltage applied to equipment exceeds a critical value. *Model 1* consists of relay rack console and separate transformer unit. Bulletin 66-24.

James G Biddle Co, 1316 Arch St, Philadelphia 7, Pennsylvania



Snap-action type thermostats

1128 • Liquid-filled snap-action thermostats combine good sensitivity and 20 to 35-amp load carrying capacity. Available in two models for remote or direct (local bulb type) installation. Local bulb unit is designed for use over an adjustable 50 to 300 F range. Remote model is available in two ranges—50 to 250 F and 150 to 550 F. Full details on request.

Fenwal Incorporated, Ashland, Mass.

Stationary batteries

1133 • *PlastiCell* and *PlastiCal* batteries, specifically designed for use in switchgear control and auxiliary power applications, are available in capacities from 10 to 770 amp hr. *PlastiCell* is designed for life expectancy of 14 yrs in full-float service while *PlastiCal* line featuring lead calcium grids has life expectancy of 25 yrs in full-float service. Complete data on request.

C&D Batteries Inc, Conshohocken, Pa.

Flexible braid connector

1134 • Insulated connector provides protection against corrosive atmosphere and abrasive particles. Made of flexible, flat, tinned copper braid with seamless copper ferrules on each end, it is especially suited to plating operation applications. Braid section is covered with vinylite and secured within ferrules by compression.

Burndy Engineering Co, Inc, Norwalk, Connecticut

Exit lights and safety signs

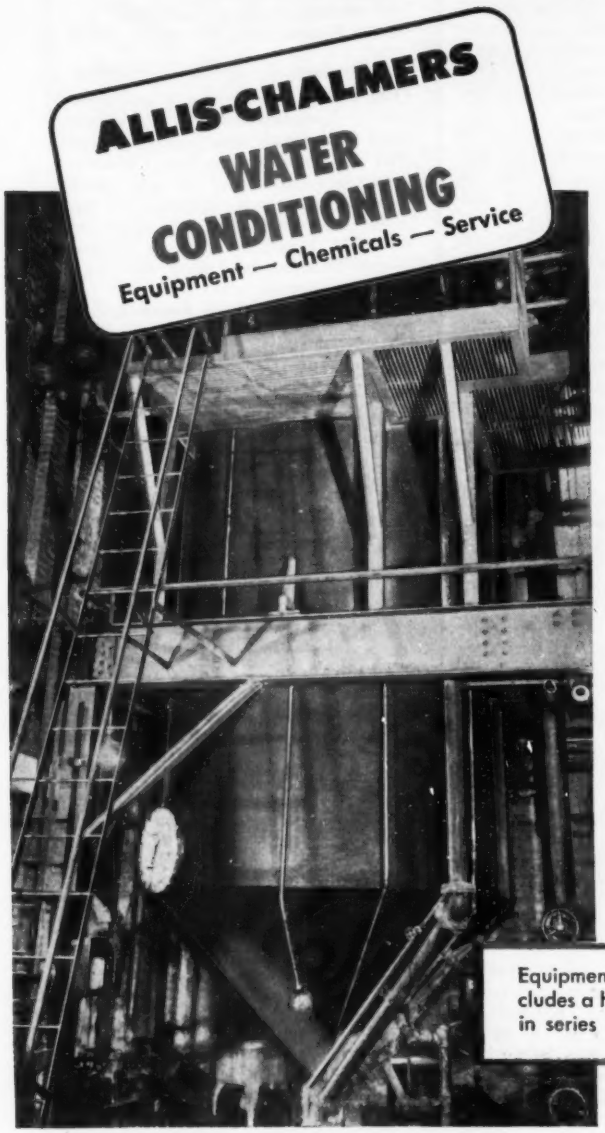
1135 • Units are designed to operate from regular 115 volt lighting circuit and in addition provide instant, automatic emergency light when that power source fails. This is accomplished by batteries contained within the unit and a relay that closes the low voltage circuit automatically whenever 115-v service fails.

Electric Cord Co, 195 William St, New York 38, New York

For more data on these items, use post cards p 169. Identify your request with item number.

Minneapolis Gas Co., Minneapolis, Minn., Gets...

MORE BOILER FEEDWATER



How to increase feedwater supply without adding excessively to chemical and equipment costs? That was the problem at Minneapolis Gas Company, Minneapolis, Minn., when installation of new equipment increased demands on the power plant.

Allis-Chalmers water conditioning engineers solved this problem with a hot lime, ion exchange system that provides zero hardness, extremely low silica content, low alkalinity and low CO_2 in steam. Chemical costs are very reasonable, since only salt and lime are needed. An added dividend can come from the small amount of space required for equipment — for example, in one installation of this type, the resin tanks are tucked under the basement stairs.

Solve Any Water Problem

You can find a solution to any water conditioning problem by consulting with an Allis-Chalmers water conditioning expert. Allis-Chalmers will provide analysis and a complete recommendation, in addition to supplying you with the chemicals and equipment you need.

If you would like to learn more about the hot lime, ion exchange process outlined above, get a copy of Allis-Chalmers Water Conditioning Informational Bulletin 49 from your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4403

Equipment similar to this at Minneapolis Gas Co. includes a hot process lime-soda softener which is placed in series with the hot zeolite (ion exchange) unit.

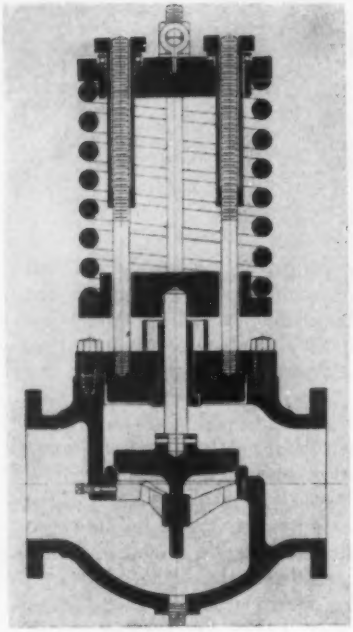
ALLIS-CHALMERS

More EQUIPMENT NEWS

Begins on page 160

Check these three items . . .

they may be the answer to your valve problems



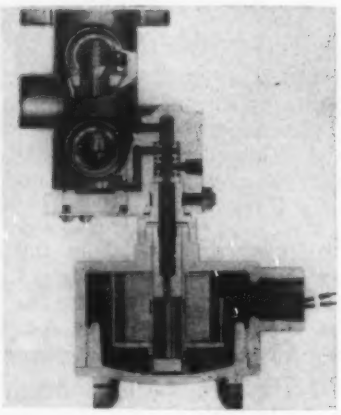
This relief valve features single spring construction

1114 • Single spring construction is claimed to eliminate unstable superstructure of conventional multiple spring relief valves. Design keeps over-all spring length at a minimum. This factor, combined with large coil diameter and heavy wire cross section, results in a 1/r ratio that provides maximum spring stability. Manufacturer states that spring is constructed so there is the least possible difference between pressure required to unseat the valve and that required to force it full open.

Guiding spindles at top and bottom of valve disk are said to assure accurate seating, permit use of valve in any position, and allow installation in either vertical or horizontal pipelines.

Thrust bearings are used under the spring nut when high relief pressures require greater spring forces. Outer collar around yoke bushing acts as stop for spring plate, permitting removal of entire yoke assembly without disturbing spring assembly and with minimum spring expansion. Full details from manufacturer.

Schutte and Koerting Company
Cornwells Heights, Bucks Co, Pa.



Solenoid air valve

1113 • Explosion-proof air valve features extremely short solenoid stroke that, in conjunction with pilot operation, is claimed to eliminate coil burn out. Poppet design with linear sealing contact on resilient seats makes both pilot and main valve self scavenging. This design has proved effective for dusty installations such as on cement batching equipment.

Other features include: removable explosion-proof housing for quick access to the solenoid and interchangeable coils for ease in converting to any standard voltage by simple coil changes. Further information available upon written request to the manufacturer.

Barksdale Valves, 5125 Alcoa Ave,
Los Angeles 58, California

Packless solenoid valve

1112 • Compact 2-way solenoid valves may be used for controlling flow of air, gas, water, light oil and other non-corrosive fluids. Units are available for ⅜, ½, ¾ and 1-in. pipe sizes and may be used on standard ac and dc voltages; power consumption is 10 watts. Valves are normally closed, with maximum ac pressure of 200 psi on air, or normally open with maximum ac pressure of 250 psi on air. Standard, watertight or explosion proof solenoid enclosures are available. Further informaton in manufacturer's bulletin 708.

Automatic Switch Company
391 Lakeside Ave, Orange, N. J.

Compressed metal packings

1121 • *Relief 101* packing is made from soft babbitt foil metal that is shredded and coated with a binder-lubricant compounded for each service requirement. It is recommended for temperatures to 550 F and especially for centrifugal rods. *Relief 201*, made from annealed, pure copper foil, will stand over 1500 F. *Relief 301*, made from aluminum foil metal, is recommended for temperatures to 1050 F. Manufacturer states that these packings are compressed in precision molds under 2000 lbs pressure to exactly fit the stuffing box.

Relief Packing Company,
6523 Euclid Ave, Cleveland, Ohio

Chemical, hydraulic packings

1122 • *Style 148* packing is impregnated with a lubricant that protects asbestos fibers from caustic liquids being pumped. *Style 134*, braided from blue African asbestos, is recommended for acid pumps. *Style 220*, glass, is recommended for some chemical service. *Style 246*, rayon, and *Style 211*, ramie, are used in hydraulic service. Full details of these packings on request to manufacturer.

Standard Packing Company,
6523 Euclid Ave, Cleveland, Ohio

Metallized packings

1123 • Instead of coating packings with graphite, low and medium pressure steam packings are coated with aluminum so finely pulverized that it acts as a lubricant. Manufacturer claims aluminum fills small cracks and crevices on rod or plunger to make a smoother wearing surface and reduce friction. Packings for higher steam pressures are metallized with copper.

The Hollow Center Packing Co,
6523 Euclid Ave, Cleveland, Ohio

Gasoline packings

1124 • Hydraulic packing, *Style 23*, made with red compound and constructed with hollow center, is adaptable for use on reciprocating pumps handling gasoline. Center hole absorbs part of swelling and balance is controlled by stitching the packing through from all four sides. Company claims it will stop leakage on worn rods or plungers. Asbestos *Style 1222* packing for pumps handling petroleum products can be added next to gland to stop leakage and postpone repacking.

The Hollow Center Packing Co,
6523 Euclid Ave, Cleveland, Ohio

Portable potentiometer

1150 • This potentiometer is suited for precise laboratory work, as well as maintenance and service work in the plant or field. It may be used with all commercial thermocouples. Large 40 in. scale is readable to .025 mv. Built-in thermometer facilitates measuring cold junction temperatures. Full details on request.

Wheelco Instruments Div,
Barber-Colman Co, Rockford, Ill.

For more data on these items, use post cards p 169. Identify your request with item number.

Look into
REVERE EXTRUDED SHAPES
—it may pay you as it did Westinghouse

When engineers of the Westinghouse Electric Corporation, East Pittsburgh, Pa., designed an inner-cooled generator rotor, the problem of making the hollow rotor coils arose. It was decided to make these out of two channel sections, butted together. Such channels could be made by milling solid copper bar, but Westinghouse knew how expensive such a process is. Could Revere produce the channels by the extrusion process? We thought we could, and after close collaboration with Westinghouse engineers, the various design and extrusion requirements were finalized. The channels are extruded, drawn, annealed, and then given a final draw.

Generators containing these special rotors are cooled by forcing hydrogen through the inner-cooled conductors at 30 psig. Because the heat is picked up directly from the copper, cooling performance is greatly increased over former designs. As a result, generator output can be approximately doubled without increasing physical size. To put it in other ways, output is increased per pound of generator weight and per pound of fuel.

Extruded shapes can save a great deal of machining time and money, and make new ideas commercially practical. Come to Revere for them in copper and its alloys and aluminum alloys.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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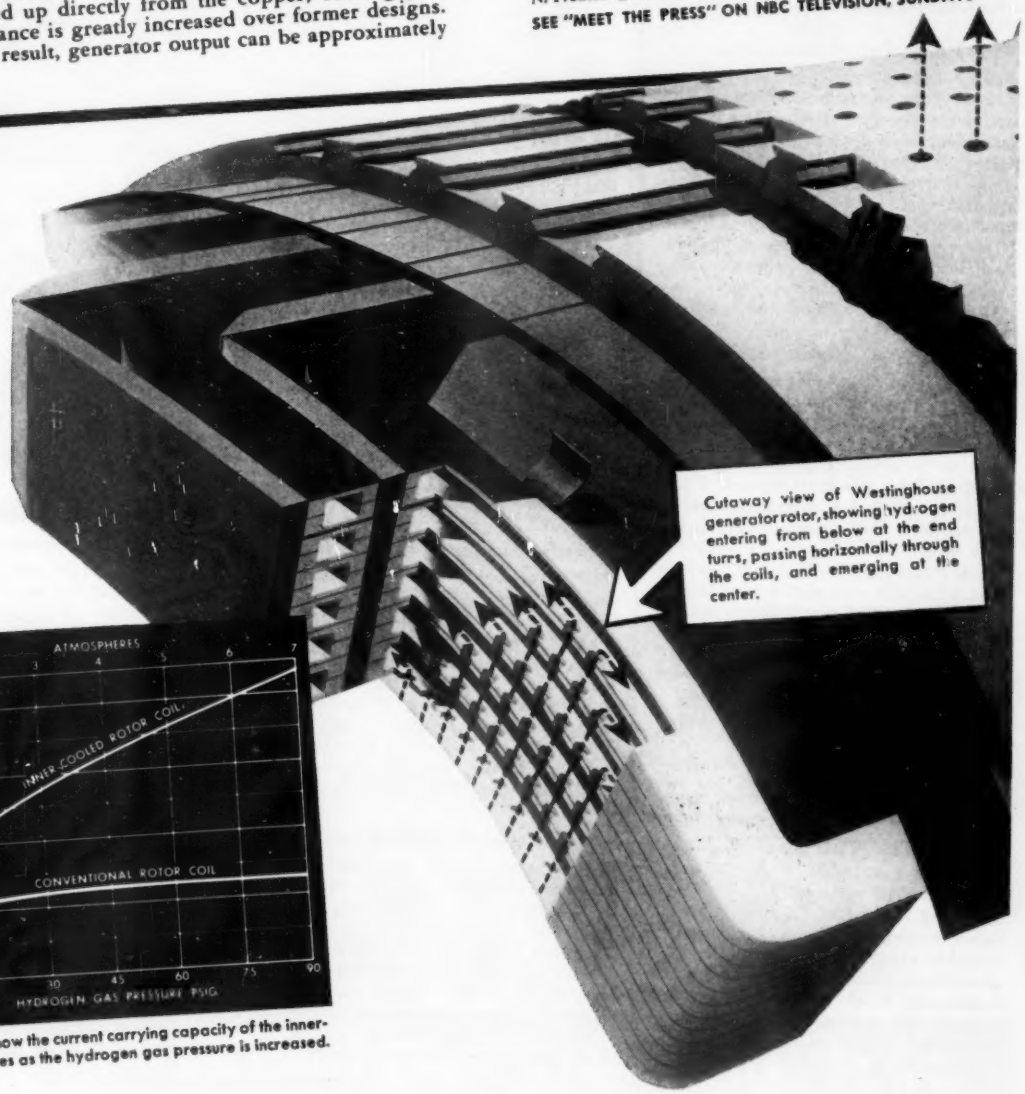
Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS



Cutaway view of Westinghouse generator rotor, showing hydrogen entering from below at the end turns, passing horizontally through the coils, and emerging at the center.

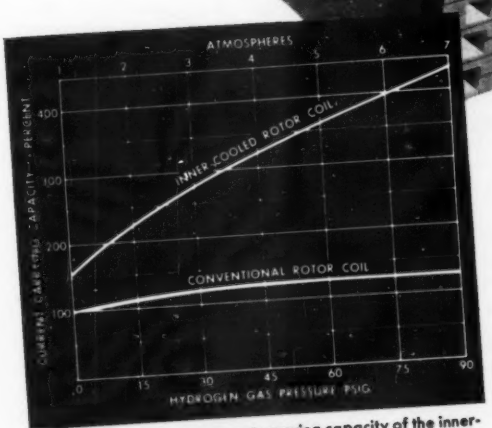


Chart showing how the current carrying capacity of the inner-cooled rotor rises as the hydrogen gas pressure is increased.

More EQUIPMENT NEWS

Begins on page 160

Improved welding wire

1120 • *Spoolalloy* welding wire for sigma and heli-arc methods of automatic welding is precision wound to eliminate kinks and insure steady flow of wire to welding head, according to manufacturer. All oxides are removed by special chemical treatment, thus eliminating main cause of poor arc and poor fusion. Available in a wide range of alloys including aluminum, monel, inconel, stainless steel, phos-bronze and hi-carbon. Details on request.

Pacific Welding Alloys Mfg Co, 312 N Ave 21, Los Angeles 31, Calif.

High-load spring wire

1126 • Stainless-steel alloy spring wire for applications where high spring loadings are required under corrosive conditions and where compactness of components is essential. Called *17-7 Ph*, it does not lose elasticity under continuous exposure to corrosive atmospheres. Sizes to ⅛ in. Full details available from manufacturer.

National-Standard Co, Niles, Mich.

Forged steel gate valves

1151 • Longer wearing wedges, stronger stem-to-wedge connections and a union bonnet giving increased efficiency are claimed features of newly designed forged steel gate valves. Wedges are made of 13% chrome stainless steel for corrosion resistance and are duracased to at least 1000 Brinell hardness. Stem-to-wedge connection is said to increase pull-out strength to many times theoretical requirement. Full information available in bulletin 195.

Ohio Injector Co, Wadsworth, Ohio

Chrome plating unit

1152 • Designed for wide range of applications with smaller components and tools, *Model 75 Chromplater* will deposit hard chrome plate as fast as .002-in. per hr on areas to 25 sq in. Completely packaged unit includes a powerstat to control rate, reversing switch for stripping, voltmeter and ammeter. Unit operates from standard 110-v 60-cycle power source. Plating unit contains 13x13x11-in. deep tank, exhaust hood, adjustable work platform and thermostatically controlled electric heater to maintain plating bath at most efficient temperature. All types of metal may be plated, including sintered carbides and aluminum. Complete details available on request.

The Dawson Corp, 302 5th Ave, N Pelham, N. Y.

For more data on these items, use post cards p 169. Identify your request with item number.

CHECK THESE TOO . . .

Motorized gas valves	p 174
Mill-type grid resistor	p 176
Electrical cable reel	p 178
Selector control or pumps	p 180
Portable electric plants	p 182
Aluminum cable adapter	p 184
Continuous level indicator	p 184
Free-moving refractory tiles	p 186
Horizontal unit heaters	p 188
Floatless level control	p 190

Latest developments in the welding field

Rectifier-type welder

1115 • This 300-amp, NEMA-rated, rectifier-type welder features quiet operation and low maintenance cost. According to company, unit offers full-time arc force control for holding very short arcs with deep penetration. Current range of 20 to 375 amps is provided. Unit utilizes moving primary coil design, obtaining current adjustments by separation of primary and secondary coils. Windings are aluminum, and silicone insulation is used on all coils. Removable side covers simplify maintenance. Available for 220, 440 or 550 volt operation. Bulletin GEC-1267.

General Electric Company, Schenectady 5, New York

Heavy-duty ac-type welder

1117 • Unit is available in 300, 400 and 500 amp sizes for a wide range of ac welding production jobs. It has no moving parts, core and coils being anchored in place, and is capacitor equipped for power factor correction. Shell-type transformer design and use of special steel in cores is claimed to keep no-load losses to minimum and increase full load efficiency. Secondary winding supplies current to control rectifier, that is of standard selenium type—40 volts dc for safe, low voltage remote control. No high voltage appears across any control coils. Control is sensitive to a wide range of welding conditions and highly responsible to changing arc conditions.

Hobart Brothers Company, Hobart Square, Troy, Ohio

Semi-automatic welding unit

1118 • Portable unit regulates arc and wire-feed automatically, yet retains visibility and flexibility of manual welding. Machine is adaptable to a variety of weld metals, including mild steel, manganese steel, hardfacing alloys and semi-automatic submerged welding. Minimizes weld craters; eliminates electrode stub ends. Full details on request to manufacturer.

American Brake Shoe Co, Amsco Div, 230 Park Ave, New York 17, N. Y.

Portable maintenance welder

1119 • Hand-carried unit, weighing only 59 lbs, welds with 5/32-in. electrodes while operating on any single phase 110-v current. Claimed particularly advantageous for maintenance and repair of heavy equipment as low maximum load output eliminates danger of electrical shock. Low voltage of welder minimizes carbon precipitation to reduce brittleness in the weld.

Royal Arc Industries, Inc, Chillicothe, Illinois

Cast-iron welding rod

1141 • Copper-coated cast iron welding rod is metallurgically compounded so average torch welder can get strong (48,000 psi, tensile) machinable welds that are free from blow holes. Rod has working temperature of 1400 F and develops Brinell hardness of 170-200. Copper coating prevents rusting common to cast iron rods.

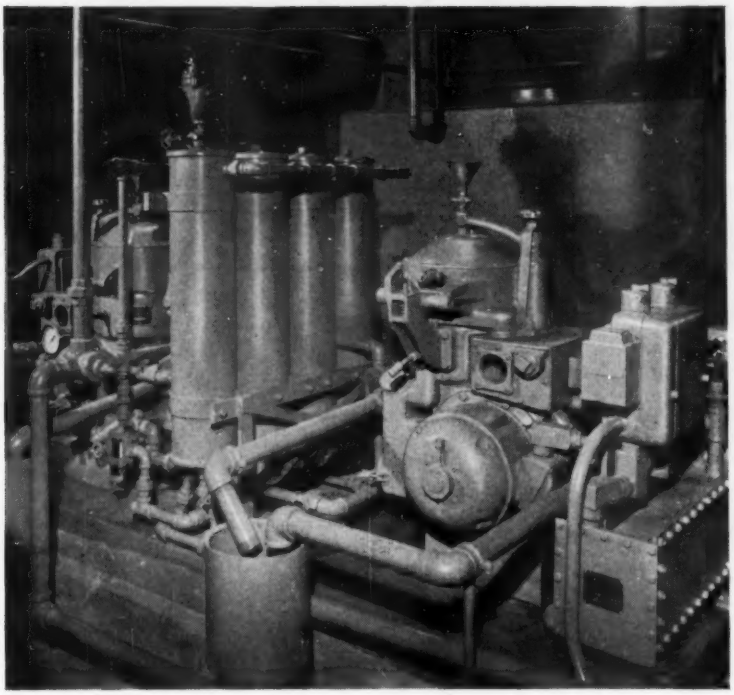
All-State Welding Alloys Co, Inc, 249 Ferris Ave, White Plains, N. Y.

Hard-facing electrodes

1142 • Electrode produces high tensile strength for many applications including frogs and switches. Manufacturer especially recommends it for build-up work on manganese castings. Called *Moly-Mang* it develops hardness of deposit of 5 to 10 Rockwell C scale; will work harden to 50 Rockwell C when subjected to peening.

Mir-O-Col Alloy Co, Inc, 312 N Ave 21, Los Angeles, Calif.

YOU KNOW you're safe when a De Laval "Puri-filter" guards your Diesel Lube Oil...



YOU KNOW that every bit of solid contaminant is being removed—even down to particles as fine as *one micron* (0.000039 in.) . . . . .

YOU KNOW that every drop of water is being taken out of the oil . . . . . .

YOU KNOW that ring sticking is being practically eliminated, time between crank case cleanings stretched out, oil life prolonged . . . . . .

YOU KNOW that you've provided the utmost in dependability—a De Laval "Puri-Filter" will never let you down.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York • 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5

DE LAVAL

LUBRICATING OIL PURIFIERS

"You see Powell Valves everywhere! And with . . .

. . . good reason! They're famous for dependability. Economical, too.
What's more, Powell has a complete line."

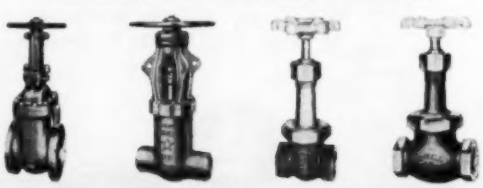
Famous for dependability

SINCE 1846

Wherever flow requires dependable control, there's *the* place for Powell Valves. Powell probably makes more kinds of valves and has solved more valve problems than any other organization in the world.

Available through distributors in principal cities. Made ⅛" to 30" and for 125 pounds to 2500 pounds W.S.P. Bronze, iron, steel and corrosion-resistant metals and alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

CONTROLS FOR THE LIFE LINES OF INDUSTRY



Powell Valves

108th year

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item write its number here →

New free catalogs and bulletins are listed beginning on back of this page. To order those you want, write in their item numbers here →

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I want details on these New Products:

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Send me these FREE Bulletins:

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Please use before March 1, 1955. Void after this date. **11/54**

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

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My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

This month's FREE Literature

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Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

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Power
Reader Service Department
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New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

HEATING AND VENTILATING

1 **Warm-air space heaters,** oil or gas fired. Photos, applications, engr data on 200,000 or 250,000 Btu per hr capacity units. Eight-page bulletin 552. Dravo Corp, 1303 Dravo Bldg, Pittsburgh 22, Pennsylvania.

2 **Cooling towers,** construction and applications. Photos, cutaway and exploded drawings show detail of structural and mechanical equipment. Two-color, 36-page bulletin CT-ID-0.002, The Fluor Corp, Ltd, 2500 S Atlantic Blvd, Los Angeles 22, California.

BOILERS AND AUXILIARIES

3 **Automatic boilers,** packaged type, 20 to 600 hp. Cutaway, photos in 4-page bulletin BE-4. Shows method of injecting air through static turbine-like vanes into burner. Boiler Engr & Supply Co, Inc, Phoenixville, Pa.

4 **Combination oil-gas burners,** horizontal rotary-nozzle mix type. Diagrams, specs in 4-page bulletin 176. Preferred Utilities Manufacturing Corp, 1860 Broadway, New York, N. Y.

5 **Streamlined baffles.** More than 30 boiler-setting plans are shown, with analysis of how each arrangement of tubes is baffled to meet specific boiler design. Photos, diagrams in 20-page bulletin BW-54. The Engineer Co, 75 West St, New York 6, New York.

6 **Refractory concrete** to withstand service temperatures to 2600 F. Photos, charts, tables in 16-page manual. Luminite Div, Universal Atlas Cement Co, 100 Park Ave, New York 17, New York.

7 **Circular arches,** sectionally suspended, for rotary hearth furnaces. Photos, construction data in 4-page bulletin 554. Geo P Reintjes Co, 2517-19 Jefferson St, Kansas City 10, Mo.

8 **Bonding mortars,** high temperature, cold-setting types. Two, 2-page bulletins give applications, outstanding features. Harbison-Walker Refractories Co, Farmers Bank Building, Pittsburgh 22, Pennsylvania.

ELECTRIC CONTROLS

9 **Industrial relays.** Dimensions, diagrams, specs for plug-mounted Classes A, B, F, S and Z relays. Two-page circulars 1801-1805. Automatic Electric Sales Corporation, 1033 W Van Buren St, Chicago 7, Illinois.

10 **Adjustable time delay relays,** hermetically-sealed. Details on housing, settings, motors, operation, calibration in 2-page bulletin AWH-TD401. A W Haydon Co, 230 N Elm St, Waterbury 20, Connecticut.

11 **Repeat cycle dial timer** controls two independently adjusted load circuits. Photos, wiring and application diagrams in 4-page bulletin N-80. Automatic Temperature Control Co, Inc, 5212 Pulaski Ave, Philadelphia 44, Pa.

12 **Induction motor starters,** *type ZHA,* for 2200-5000 volt motors. Photos, applications in 8-page folder 1060. Electric Controller & Mfg Co, 2698 E 79th St, Cleveland 4, Ohio.

ELECTRICAL EQUIPMENT

13 **Distribution transformers,** withstand submersion without damage or service interruption. Construction features, mechanical data in 6-page bulletin 51B6333A. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

14 **Load center transformers** in ratings to 2500 kva. Photos, dimensions, weights, diagrams in 20-page bulletin 132. R E Uptegraff Manufacturing Company, Scottdale, Pa.

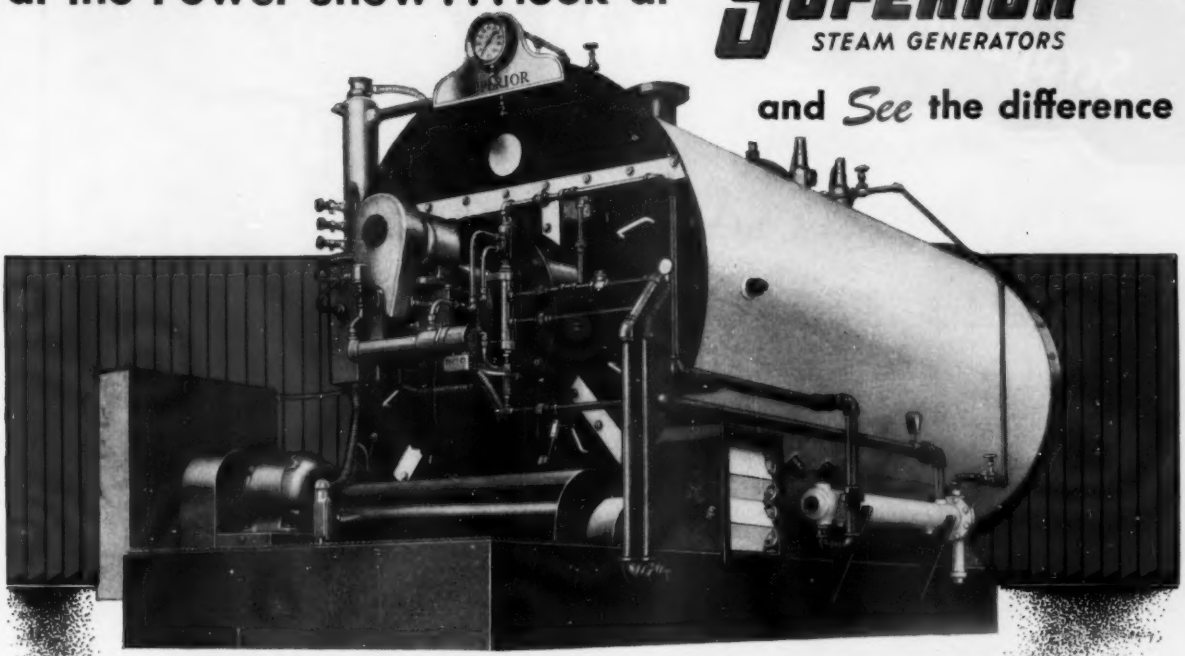
15 **"Tools of Automation,"** a 12-page booklet describing motors, drives, control and regulators. Reliance Electric & Engineering Co, 1076 Ivanhoe Rd, Cleveland 10, Ohio.

16 **Electric power apparatus,** protection of equipment used in chemical industry. Illustrated 32-page bulletin 8YN-41. Electric Machinery Mfg Co, Minneapolis 13, Minnesota.

(*Continued on page* 236)

at the Power Show . . . look at SUPERIOR STEAM GENERATORS

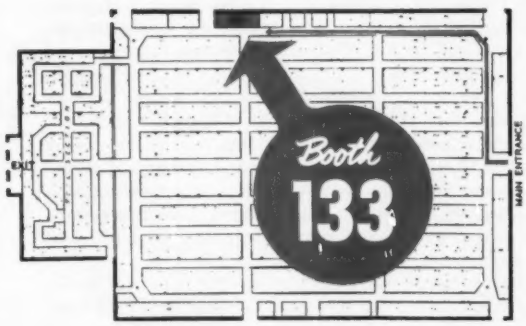
and *See* the difference



HERE'S WHAT TO LOOK FOR:

POWER SHOW

DEC. 2nd through DEC. 7th



COMMERCIAL MUSEUM
PHILADELPHIA

Look . . . at Superior's 4-pass fire-tube design . . . ample heating surfaces with a minimum of 5 sq. ft. per b.h.p.

Look . . . at Superior's built-in multiple induced-draft fans . . . drawing evenly across the entire tube area, and eliminating the need for an expensive chimney.

Look . . . at Superior's Rotary Burner with its own fan supplying primary air . . . fully automatic with oil or gas, or both . . . change from either fuel to the other quickly, without dismantling equipment or interrupting steam supply.

Look . . . at Superior's safety features . . . induced draft which prevents the escape of combustion gases into the boiler room . . . fool-proof combustion gas pressure-relief port . . . constant gas pilot throughout gas firing periods . . . dual purging of all gas passages, both before and after firing.

Look . . . at the overall picture . . . a complete packaged steam plant. One purchase shipped completely assembled after factory test to assure dependable operation at a guaranteed thermal efficiency of more than 80%.

Look . . . at Superior's catalog for the complete story. If you're not going to the show, write for Catalog 600.

for performance you can **BANK** *on*

SUPERIOR STEAM GENERATORS

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

George Edwards' Scrapbook

Nature lifts water 300 feet

A giant sequoia tree lifts water into its leaves 300 feet above ground, while in contrast your pump raises water only 34 feet (theoretically). This higher lift is due to "negative pressure" of water, according to Dr L J Briggs, dean of American science. Under right conditions, water can be pulled 9000 feet high, he points out.

By spinning a Z-shaped capillary tube of water at high speeds, he has obtained a limiting negative pressure for water of 273 atmospheres, or about 4000 psi. This means that the water column in the tube did not break and fly out the open ends until centrifugal force due to spinning was equivalent to pull of column of water 9000 feet high.

In case you want to do something with this idea, go right ahead—it should have possibilities.

Have you seen these models?

Do you know where to find one of these old-timers?

Lenoir gas engine or an Otto and Langen gas engine
Francis hydraulic turbine (preferably cutaway)
Pelton hydraulic turbine, early model
De Laval steam turbine, early model
Diesel engine, early model

If you do, write R P Multhauf, Smithsonian Institution, Washington, D. C. These are some of the models he hopes to get for enlarging his interesting power-equipment collection in the near future.

I like lots of ads

Ever go window shopping? The wife and kids often come with me on a week-end business trip to Chicago. Usually we spend several hours window shopping in the loop area. The wife tells me she enjoys it because there are so many stores concentrated in one area, in contrast to our small town.

That got me to thinking why I like magazines with lots of advertising. In each issue, so many manufacturers show products I'm interested in that I can do all my shopping between the two covers. When I checked this with Editor Lou Rowley, he assured me that I'm right.

"Many readers write in that they always go through our many ads *first*, before settling down to the articles," was Lou's answer. "Fact is," he continued, "some tell us they enjoy our ads as much as the editorials." How do you read a magazine? If you are the average reader, bet you'll find yourself going through the ads before you sink your teeth into an article. If I'm wrong, let me know.

Here's one idea on retiring

Dear George: With thoughts of retiring, I bought 40 acres down here. It has an ancient grist mill that I plan to rebuild, then I'll install an up-to-date water turbine. I already have the turbine and a 15-kva alternator with a dc generator for field excitation. Unit will be mainly for heating my house—for pumping water—running my work shop. But we have droughts so I'll still use Duke power.

I'd like to find an old one-cylinder diesel of 25 hp to augment the water. Rebuilding water power should be interesting, full of fun and hard work. I have most tools and equipment but I won't have *time*—until I retire.

My collection of guns, modern and old, needs repairing and refinishing. I'm looking forward to that job also. Then I like target shooting and experimenting with guns. Rebuilding my old cars and duplicating one of the simpler one lungers will be fun. I already have two Franklins and parts of six Ford Model T's to start with. I have just rebuilt a Ford V-8 engine and installed it in a 1932 sedan. I'm now looking for other old cars—one with a Knight engine.

I bought a fine little German 35-mm camera for taking stills. Also, I want to visit junk yards and buy old pieces of equipment and make them work. I just got an air compressor, two small gasoline engines, several electric motors, several water pumps and numerous pieces to build into useful gadgets.

I expect to spend many days at our fine museums you've been writing about, Smithsonian in Washington, Science & Industry in Chicago and, most of all, Ford's Museum at Dearborn that I've already visited three times.

My latest interest is the helicopter. This machine solves many of our transportation problems. But why go on—how can I ever find enough time, even *after* I retire, to do all the things I want to do? —Ed Bertalan

My item on retiring, in the September issue, brought this interesting letter from Ed Bertalan, mechanical engineer for Western Electric Co, in Winston-Salem, N. C.

George Edwards
Engineer

ARE CLOGGED LINES LIKE THESE CUTTING YOUR WATER SUPPLY?

Over 1½ Miles of Buried Water Line Chemically Cleaned IN PLACE by Dowell Service

You don't have to dig up water lines in order to clean them! Take the case of a major railroad that had over 8600 feet of *buried* water lines, ranging from 2 to 12 inches in diameter. The capacity of these lines had been greatly reduced by scale deposits. Dowell Service used liquid solvents to clean all the lines, *in place*, during a period of only six days with a minimum interruption in service.

Dowell Service offers *fast*, effective chemical cleaning of pipelines of all kinds—water lines, disposal lines and product lines. And, whether these lines are underground or above, indoors or out, no digging or dismantling is necessary. Dowell solvents are designed to dissolve the accumulated deposits, and are introduced through regular connections. Because they are liquid, Dowell solvents reach wherever steam or water can flow, cleaning places inaccessible by other methods—angles, curves, valves, complicated surfaces and hook-ups. *Experienced* Dowell engineers do the job using Dowell-designed truck-mounted pumps, mixers and control equipment.

Many other types of equipment can also be cleaned chemically by Dowell. If you have boilers, condensers, evaporators, bubble towers, water wells or other operating equipment where deposits are reducing capacity, let Dowell Service *save you time and money in maintenance cleaning!*

FIND OUT ABOUT CHEMICAL CLEANING! There are many places in your plant where Dowell Service can clean equipment faster and better than out-dated mechanical methods. Call your nearest Dowell office for a fact-filled book. Or write direct to Tulsa, K-23.

DOWELL SERVICE

Over 100 Offices to Serve You with Chemical Cleaning for:

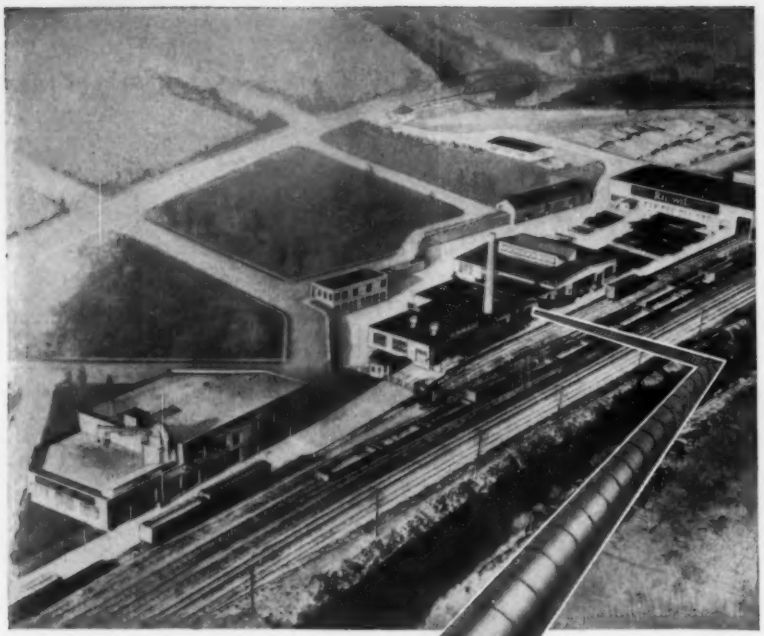
Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

DOWELL INCORPORATED
Tulsa 1, Oklahoma

DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY



NEVER ENDING LINE OF

Quality

The Ric-wil Company represents over 40 years of manufacturing Quality Insulated piping systems. The complete Ric-wil product line is continuously pre-proven by laboratory and field tests to maintain this superior quality.

Contact your local Ric-wil representative or write direct for Catalog No. 5401

Send for Catalog 5401

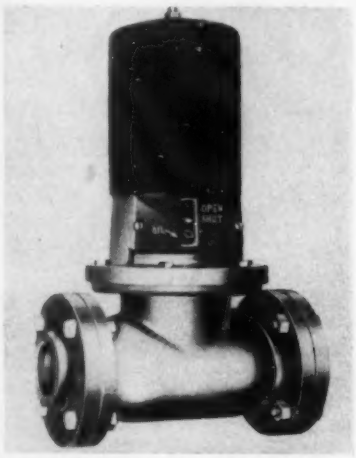
Quality Piping Systems of the . . .
. . . Highest Thermal Efficiency

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY
BARBERTON, OHIO

More EQUIPMENT NEWS

Begins on page 160

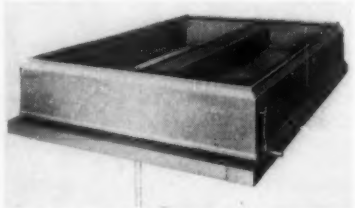


Motorized gas valves

1125 • Motorized valves are designed for automatic fuel control on gas-fired boilers, furnaces, ovens, kilns and other gas combustion systems. Units feature two-wire motor operator, soft neoprene seat construction and sturdy lightweight aluminum body. Spring loaded plunger and neoprene seat assure positive shut-off in event of electrical failure. Motor and plunger assembly are easily removed for servicing valve without breaking line connections. Available in 1 to 4-in. sizes.

Eclipse Fuel Engineering Co, Rockford, Illinois

For more data on these items, use post cards p 169. Identify your request with item number.



Fire valve roof unit

1153 • Fire valve roof unit for industrial buildings opens quickly when excess interior heat occurs. It was developed to meet the newly recognized need for fast release of heat, gases and smoke in the event of fire.

Each unit of the fire valve provides 46 sq ft of free area opening when two large dampers drop, released by a fusible link. Dampers can also be opened and closed for extra ventilation in good weather. Unit is weatherproof when closed. Bulletin available on request to manufacturer.

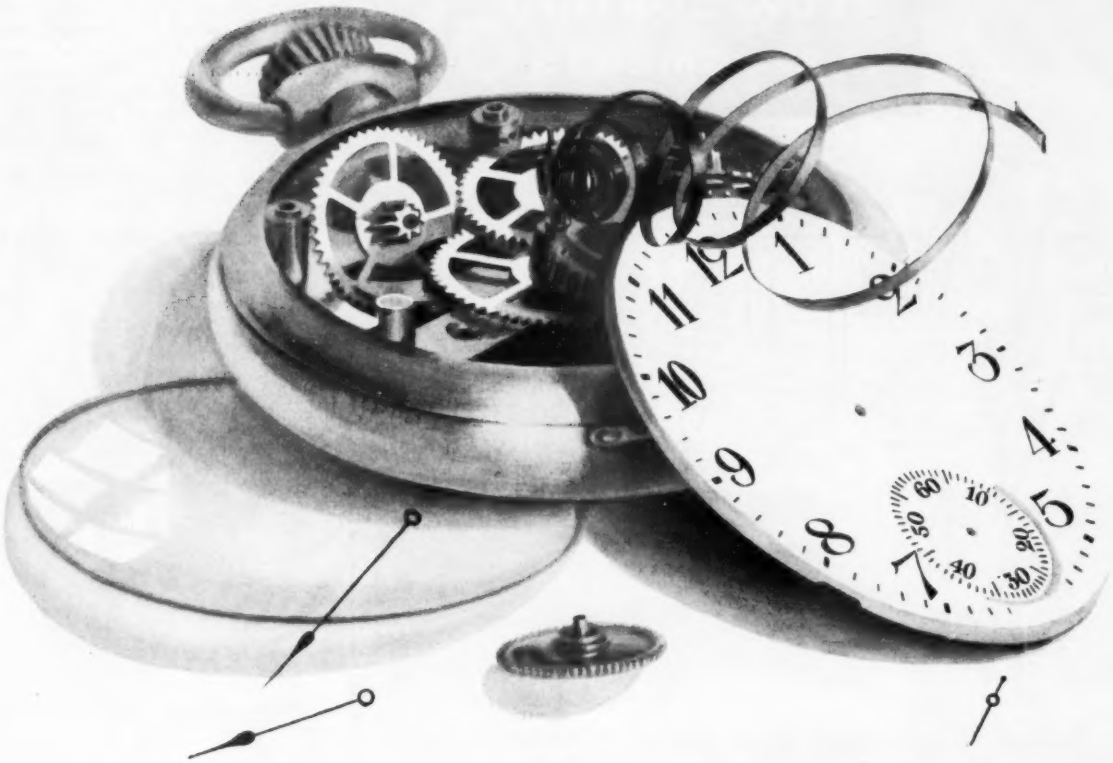
The Swartwout Co, 18547 Euclid Ave, Cleveland 12, Ohio

Watthour meter test equipment

1154 • Designed for testing watthour meters, both single and polyphase, of all types within test ranges of 120, 240, and 480 v and 0.25, 0.5, 1, 1.5, 2.5, 5, 10, 15, 25, and 50 amp. The equipment includes a new

Everything a watch should have

—except the tick!



Your plant can't "tick" properly, either—without Correct Lubrication!

Like this watch, your plant may have all the right "parts"... the finest machines made... yet may not be "ticking"—running at top efficiency—because something is lacking. That "something" is called *Correct Lubrication!*

By Correct Lubrication we mean much more than just "oil" and "grease"—which any oil supplier can provide. We mean a detailed *program* of lubrication—designed specifically for your kind of machinery and type of operation.

Working with your personnel, we analyze all your machines and their operating conditions to determine their exact lubrication requirements. Then we recommend the *right* Gargoyle product for every moving part, advise on correct methods of application, set up proper lubrication schedules, follow up regularly with progress reports on benefits achieved.

In plant after plant, such a program has effectively boosted production—materially cut maintenance costs. It can do the same for you. Why accept less?

Socony-Vacuum

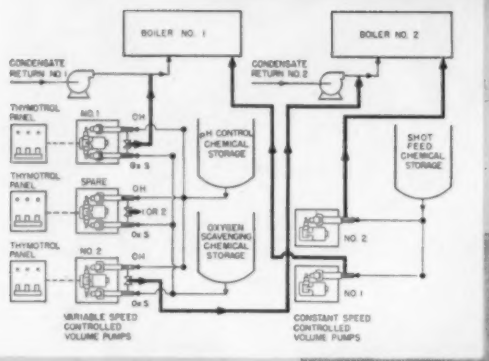
SOCONY-VACUUM

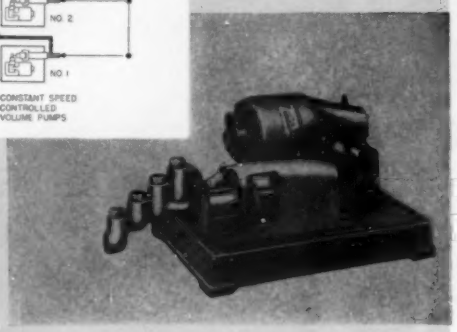
Correct Lubrication

FIRST STEP IN CUTTING COSTS

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

CONTROLLED VOLUME PUMPS ARE FLOW-CONTROL INSTRUMENTS





Major utility standardizes on controlled volume pumps

Philadelphia Electric utilizes Milton Roy pumps in connection with the boiler feed water treatment system in each of its seven power stations.

Standardization proves profitable. Automatically controlling the metering of treating chemicals, this universal treatment method assures complete control over many problems of power plant operation.

Flow-control instrumentation of this type is representative of the use of Milton Roy Controlled Volume Pumps. Other applications include flocculation control in clarifiers, corrosion control in boilers, and pH control.

Similar systems can help you solve *your* low-capacity flow control problems. Write for Data Sheet D-54-2 which describes fully the Milton Roy System . . . and Bulletin 553, "Motor-Driven Pumps."

Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa

MILTON Roy COMPANY

Manufacturing Engineers

1305 E. MERMAID LANE • PHILA. 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

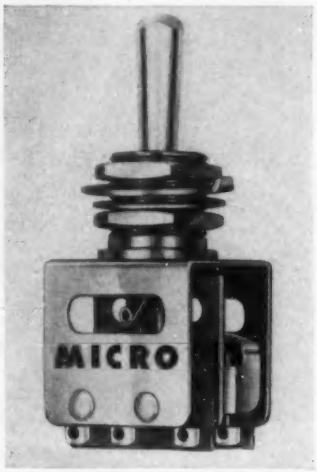
More EQUIPMENT NEWS

Begins on page 160

switching arrangement for connecting meter elements so that both 2- and 3-element polyphase meters can be tested without manually changing the connections.

Also included is a higher insulation test voltage, added capacity in the loading transformer, and a constant selector whereby the basic constant of the rotating standard can be adjusted to match the basic constant of the meter under test. Unit can test both elements of a single-phase, three-wire meter simultaneously while the potential links are closed. Overall accuracy of the equipment is said to be within .05%.

Electrical Facilities Inc, 4240 Holden St, Oakland 8, Calif.

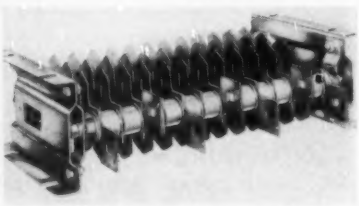


Subminiature toggle switches

1155 • Tiny 3-piston toggle switch assemblies have two single-pole, double-throw basic switching units, providing controls of four circuits. One basic switching unit is actuated in each extreme toggle position. Neither unit is actuated in center toggle position. However, two single-pole, double throw switching elements, make it possible to have three different combinations of two open and two closed circuits at any time. Electrical rating of each assembly is 125, 250 volts ac, 5 amps.

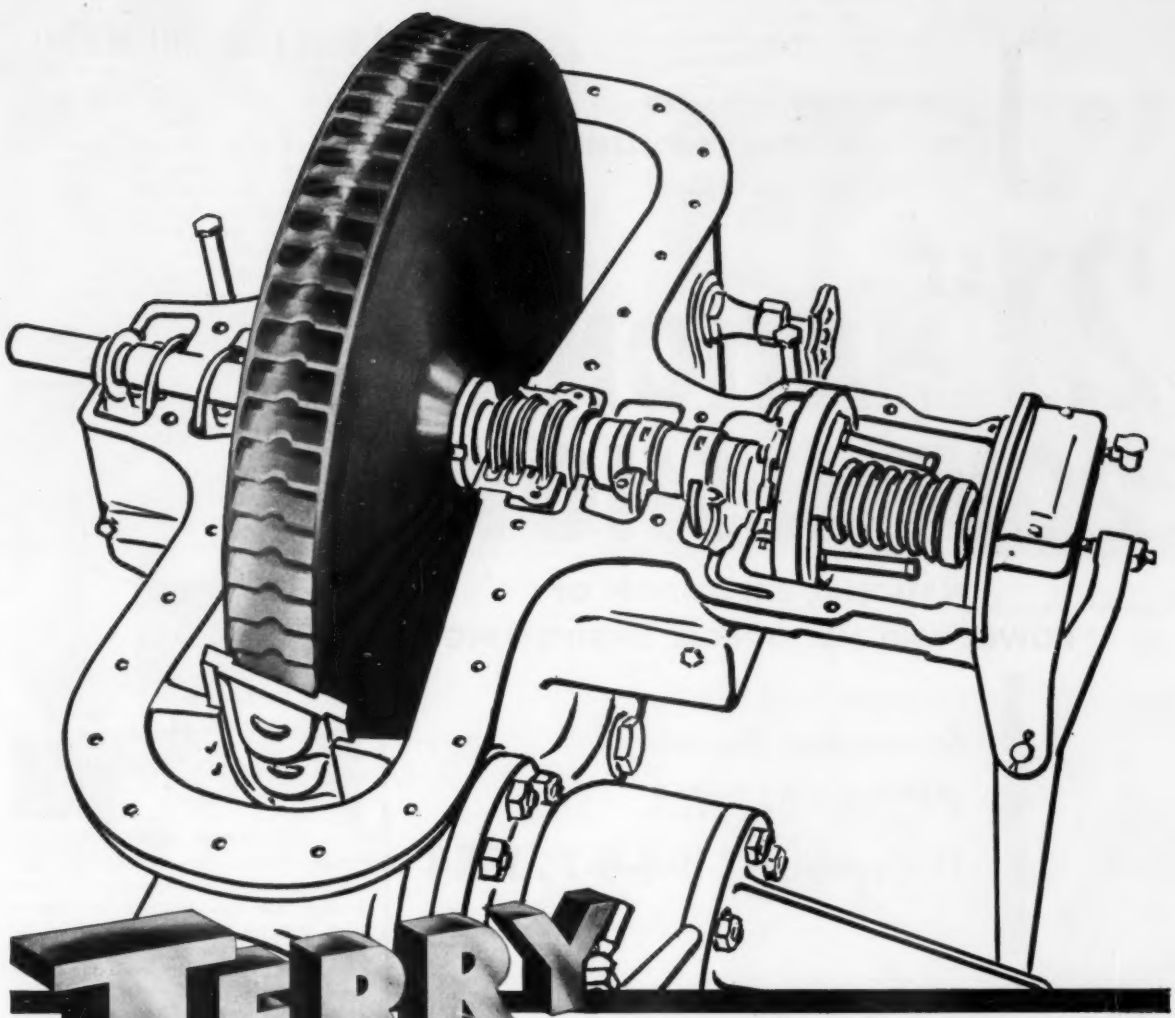
Micro Switch, Div of Minneapolis-Honeywell Regulator Co, Freeport, Ill.

For more data on these items, use post cards p 169. Identify your request with item number.



Mill-type grid resistor

1144 • More stable resistance values and longer trouble-free life are claimed features of this non-breakable, all-welded mill-type resistor. Complete grid assembly can be removed from its frame without disturbing



SOLID WHEEL RUGGEDNESS

is your turbine dividend

The rugged construction and fool-proof design of a Terry solid-wheel turbine can save you money by keeping maintenance costs to a minimum. Usually only taken down for routine inspection, any repairs that must be made are of relatively simple nature, and cost of replacement parts is small.

The rotor of the turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims of the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry solid-wheel turbine is an extremely reliable piece of equipment—why not write for complete details today? Ask for a copy of Bulletin S-116.

TT-1198

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

YOU'LL FIND ANSWERS
TO YOUR POWER PROBLEMS
AT THE POWER SHOW

21st NATIONAL POWER SHOW

NATIONAL EXPOSITION OF
POWER AND MECHANICAL ENGINEERING

Commercial Museum,
PHILADELPHIA
December 2-3-4-6-7, 1954

Questions and answers will be the order of the day—every day—at the POWER SHOW! Leading manufacturers of mechanical, steam, electrical, hydraulic and pneumatic power equipment will have their technical representatives on hand to supply the information you will need to make up-to-the-minute improvements in your plant operation.

Look for the demonstrations of:

New ideas for reducing costs, increasing efficiency, improving product design—*New methods* of power production, distribution, utilization and maintenance.

PLAN NOW TO ATTEND

Write early for hotel reservations and advance registration

Under the auspices of the ASME

Management: INTERNATIONAL EXPOSITION CO.
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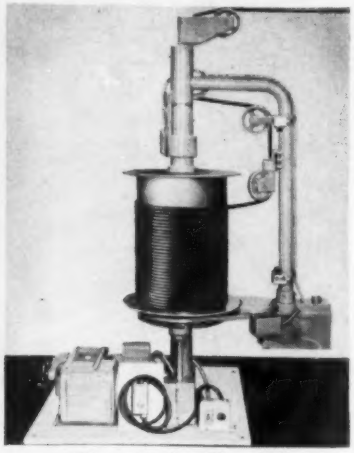
More EQUIPMENT NEWS

Begins on page 160

grid box end frames or other boxes in resistor stack. Welded current carrying junctions provide continuous path for constant resistance values, unaffected by corrosion or changes in grid rod pressures. Individual grids are non-breakable, punched from chromium steel alloy. Continuous current capacities up to 180 amps per box in ratings from 1/10 to 10 ohms are available. Grids are insulated for 600 volt service. Request bulletin EC-63.

Cutler-Hammer, Inc, 249 N 12th St, Milwaukee, Wisconsin



Electrical cable reel

1156 • Any diameter of electrical cable can be wound on new reel without disconnecting cable ends or using slip rings or other types of sliding contacts. Unit has variable speed drive and level wind mechanism that is power driven and automatically reversible. Manufacturer claims reel eliminates twists, kinks and knots during winding or unwinding and it does not interfere with operation of test equipment that may be at either end of cable.

Rodon Inc, Neshaminy, Pa.

For more data on these items, use post cards p 169. Identify your request with item number.

Asbestos insulating rope

1157 • *Caposite* pure asbestos rope is available for flexible insulation of curved and irregular piping, bends, fittings, valves, expansion joints, engine exhausts and similar uses, including furnace door packing. Rope is pure long-fiber *Amosite* asbestos rovings, twisted together to correct diameter and retained within a braided reinforced jacket of asbestos yarn. Product insulates effectively to 1200 F and is available in 100-ft coils, ½ to 2-in. diameters. Bulletin 101.

North American Asbestos Corp, Board of Trade Bldg, Chicago 4, Ill.

Graphic panel control board

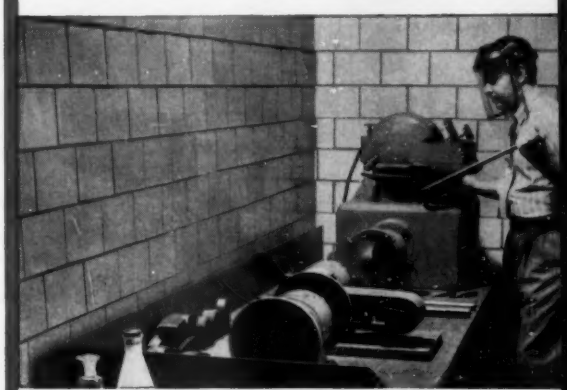
1158 • Graphic panel arrangement for automatic ion exchange equipment allows operator to see at a glance if system is functioning properly. Ion exchange units and immediate piping and valves are pictorially represented on panel control board. Colored lights indicate operation. Green

◀ Heat-treating and physical testing equipment shown at left is used for quality control of welding operators and for development of new welding procedures.

▲ This Rockwell hardness testing machine measures the hardness of weld specimens as a guide to proper procedures for heat-treating of welds.

Daily rigid testing is your insurance of quality welds in

NAVCO FABRICATED PIPING



▲ A laboratory technician cuts a sample from a pipe weld prior to grinding and polishing for metallographic examination.

▲ Here a weld specimen is etched to outline the grain structure for further metallographic study.

At Navco, a continuous parade of weld specimens are processed in the new, modern physical-chemical testing laboratory. It is here that weldments are studied metallographically and tested physically—all on a rigid schedule of quality control practices. Navco customers have benefited from progressive quality control practices for more than 40 years; they have come to know that piping installations, engineered, fabricated and erected by Navco, are precise, accurate and dependable.

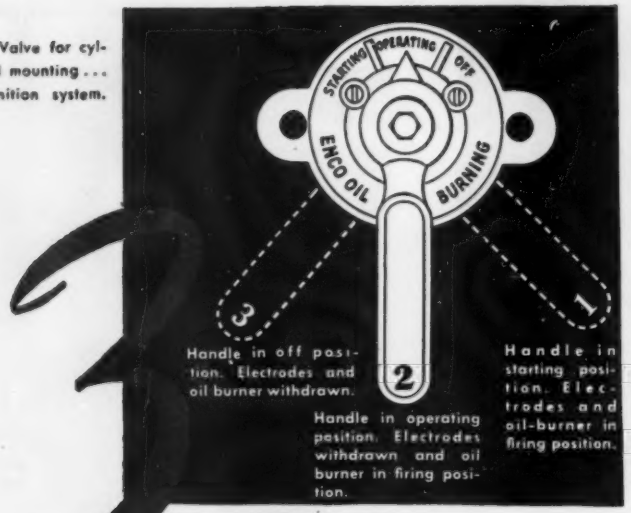
Call on NAVCO for your next piping job.

NATIONAL VALVE & MANUFACTURING COMPANY

3105 LIBERTY AVENUE, PITTSBURGH 1, PENNSYLVANIA

New York • Chicago • Cleveland • Boston • Atlanta • Buffalo • Cincinnati

Hand Control Valve for cylinders . . . wall mounting . . . oil burner ignition system.

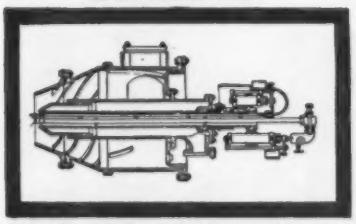


1 Step

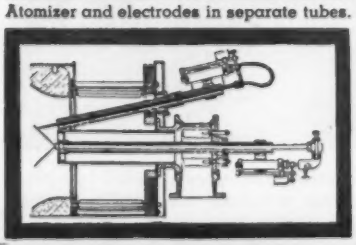
IGNITION SYSTEM
FOR PULVERIZED COAL, OIL, OR GAS

FAST
SAFE
POSITIVE

Atomizer and electrodes in the central tube.



Atomizer and electrodes in separate tubes.



With an Enco Ignition System, operator can light off any burner by movement of a Hand Control Valve, located close to the pulverized-coal mill and fan controls, and within view of the instrument board. Automatically, a powerful ignition spark is established, and the light fuel turned on. Both are interlocked electrically — the oil valve cannot be opened until the spark current is on and the atomizer is in firing position. After the oil flame is established, a second movement of the control valve retracts the electrodes, leaving the atomizer in operation.

After ignition of the pulverized coal is established, a third movement of the control valve shuts off the oil and retracts the atomizer out of the hot zone, leaving the unit ready to repeat the operation as may be needed.

The Enco Ignition System has a wide range of application. Pulverized coal, blast furnace gas or any liquid fuel may be ignited by the unit, or the spark alone may be used to ignite natural or refinery gas. The ignition flame can be changed gradually from light to heavy fuel oil if continued operation under heavy load is required. The ignition flame also can be used as a substitute for principal fuel in emergencies.

Bulletin on request.

THE ENGINEER COMPANY
75 West Street, New York 6, N. Y.

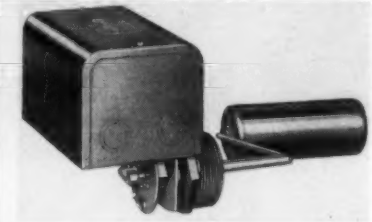
Enco OIL BURNING EQUIPMENT

More EQUIPMENT NEWS

Begins on page 160

light shows that operation valve is open; red light means it is closed. All pipe lines are also lit with a different color for each material carried, such as acid, caustic, inlet and outlet water. Printed legend on panel lets operator determine if system is functioning properly and, if not, just where the problem lies. System is especially advantageous for large utility demineralization plants, mixed-bed and two-bed demineralizers and hydrogen-sodium blend systems.

Graver Water Conditioning Co,
216 W 14th St, New York 11, N. Y.



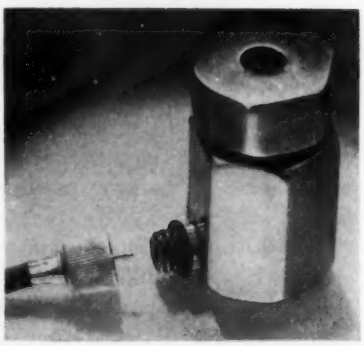
Selector control for pumps

1159 • Screw-in tank alternator provides means of mechanically alternating operation of two condensate pumps in a duplex system with a common tank. Function is to alternate cycles of operation to insure even wear of pumping units. Alternator also starts second pump in cases where additional capacity under maximum condition is required.

Switches are available for 110, 220, 440, and 550 v. Structure consists of two 2-pole, double break, silver-to-silver, visible and vertical contact mechanisms.

Square D Co, 4041 N Richards St,
Milwaukee 12, Wisconsin

For more data on these items, use post cards p 169. Identify your request with item number.



Dynamic force gage

1137 • Force gage with extended frequency range and large output permits dynamic tests of servo systems, vibration-force generators, wind tunnel balances, structures, etc. Piezo-electric gage principle is used offering advantage of sensitivity to force changes only, thus permitting full scale expansion of dynamic phenomena. *Model 2101* offers full scale output of 3 volts for each range. Sensitivity remains constant over frequency range of 10 cps to 5 kc when loaded with resistance of 100 megohms or more. Manufacturer states

ANKORITE

Black Water-proof Tape

IS

WATER-PROOF ALKALI-PROOF
ACID-PROOF ABRASION-PROOF
WEATHER-PROOF

ANKORITE BLACK WATER-PROOF TAPE is a heavy, sticky, black insulating tape, rubber free. In service, Ankorite Black Water-proof Tape splices perform a duplex function; the inner turns remain soft, adhering to the wire in a sticky insulative coating, while the outer layers fuse into solid sheath absolutely impervious to water and air.

Weather-proof and Water-proof qualities are at first glance a distinct advantage in tape which is designed exclusively to meet outdoor conditions. This Tape is free from rubber, thus assuring the user against gradual vulcanization or hardening of the tape through age.

Abrasion-proof qualities are frequently necessary in a tape for exterior use. The toughness of the compound and the strength of the fabric used in our tape insure this quality.

Acid-proof and Alkali-proof qualities become important in underground work. The viscous, bituminous base of Ankorite Black Water-proof Tape is resistant to the natural acid and alkali solutions found in mine water.

In addition, Ankorite Black Water-proof Tape is noncorrosive, nonravelling and free from pin holes.

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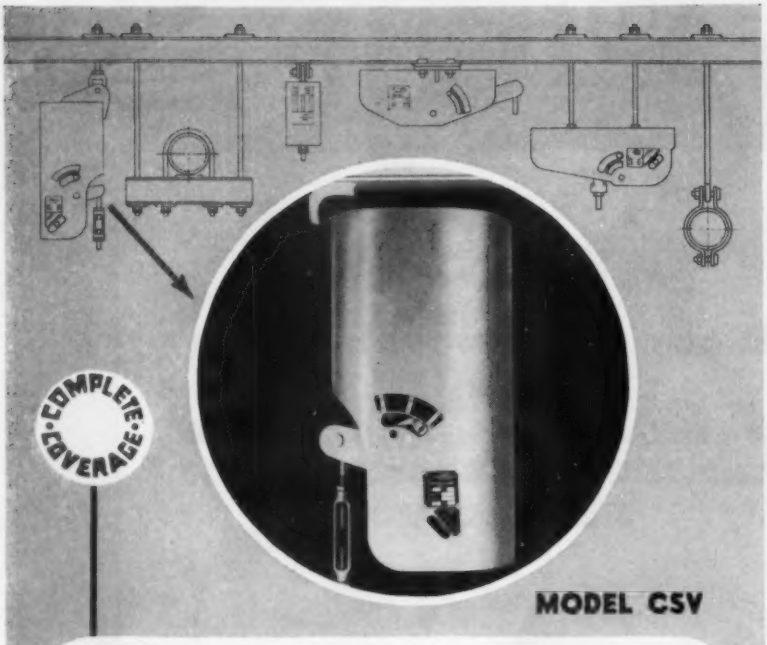
THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE



This is article number 3 in a series dealing with the subject of pipe supports in modern power and industrial plants.

The general principle of constant support design was explained in article number 2. This vertical unit is a recent development. In operating characteristics, it is the full equal of the more familiar horizontal constant support. Standard units will support loads of more than 14,000 pounds and permit travel of as much as 12 inches. Larger loads and travels are available upon application. Bergen Constant Supports are almost completely housed. The primary advantage of this vertical constant support is the manner in which it can be applied to handle difficult space conditions.

For example: A large group of risers can now be run up a common wall and supported with this Bergen CSV unit since the short dimension is in the horizontal plane. The CSV is unique in that it may easily be attached on top of, under, or to the side of a beam. The development of this vertical support provides the designer with an extremely flexible tool.

Hot and cold positions of the piping are indicated on the travel scale. The travel indicator is large and is painted **red** to facilitate reading from the operating floor.

The bearings in the vertical support (as in all Bergen units) are heavy-duty, needle type, permanently lubricated. The factor of safety of all parts, with the exception of the spring, is at least 5 in accordance with the Piping Code.

Suggestion: In selecting a constant support, always choose a unit having some reserve travel. Field conditions can vary from the theoretical.

BERGEN PIPESUPPORT CORP.
50 Church Street, New York 7, N. Y.

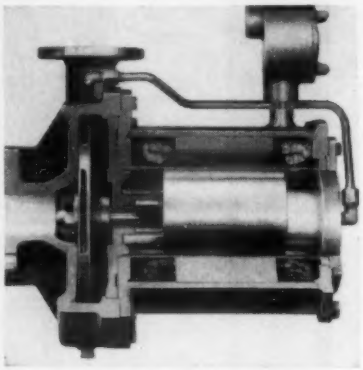
874

More EQUIPMENT NEWS

Begins on page 160

that ease of coupling and small size permit use of gage in servo linkages, force balances and mechanical systems requiring minimum mass.

Endeveo Corp, Sales Dept, 689 S Fair Oaks Ave, Pasadena 2, Calif.

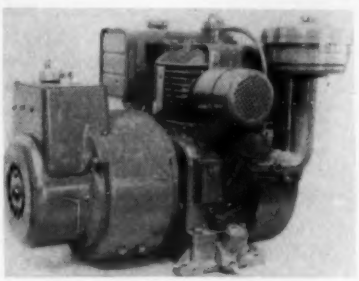


Centrifugal pump

1143 • Seal-less centrifugal pump provides guaranteed leak-proof service and offers welded construction that allows field dismantling and reassembly with no loss in leakproof qualities. Designed for use with hard-to-handle fluids ranging from butyl-acetate to titanium tetrachloride.

Chempump Corporation, Station R, 1300 E Mermaid Lane, Phila., Pa.

For more data on these items, use post cards p 169. Identify your request with item number.



Portable electric plants

1160 • Portable electric plants deliver to 2200 w, weigh just 170 lbs, and measure 21½ in. in length with width and height of 18 in. *Model 41-B* is fully self-contained with 4-qt gasoline tank. Company states unit has improved ignition system, providing abundant spark for fast starts. Engine is 4-cycle air-cooled model of 4.3 hp, operating at speed of 3600 rpm. Armature of heavy-duty generator is mounted on engine crankshaft, eliminating possibility of misalignment damage due to twist and strain.

Universal Motor Company, 527 Universal Dr, Oshkosh, Wis.

Polymerization control panel

1161 • Centralized-system for controlling continuous polymerization provides automatic flow control of raw material, catalyst and product streams. Reaction temperatures are also controlled from the 3x7-ft graphic panel. Manufacturer reports that the system using 23 air-operated flow control

V-103
Coil Valve

D-251
Piston Damper
Operator

T-800
Remote Bulb
Thermostat

T-400
Room
Thermostat

C. A. Norgren Co., Englewood, Colorado. Stanley Morse, architect; K. J. Murray, consulting engineer; Bell Plumbing & Heating Co., heating contractor, all of Denver.

One of the most modern manufacturing and office buildings recently constructed in the Denver area is the C. A. Norgren Co. building at Englewood, Colorado.

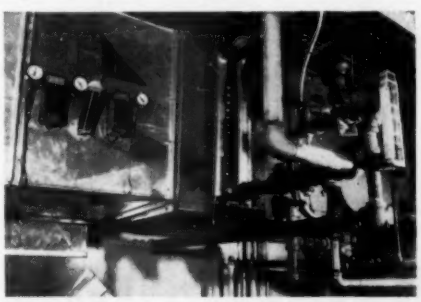
Precision regulation of the heating and air conditioning systems is provided by a specially planned system of Johnson Automatic Temperature Control. The building is heated by radiant panels and convectors. Room by room comfort is assured by strategically located Johnson *Individual Room* Thermostats which operate valves on the water supply to the panels and convectors.

Behind the scenes, other Johnson Thermostats operate Johnson Valves and Damper Operators on the four central fan heating and air conditioning systems which serve the executive, sales and general offices, the engineering department and the lobby area.

All control apparatus is combined in a single "Planned-for-the-Purpose", "Installed-for-the-Purpose" control system resulting in maximum comfort and savings from every heating and cooling dollar spent.

Johnson Automatic Control Systems are always designed specifically for each individual installation. Let a Johnson engineer from a nearby branch office provide the answer to your temperature regulation problems. There is no obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

In the engineering department, Johnson *Individual Room* Thermostats maintain ideal working temperatures by operating convector valves and regulating the supply of conditioned air.



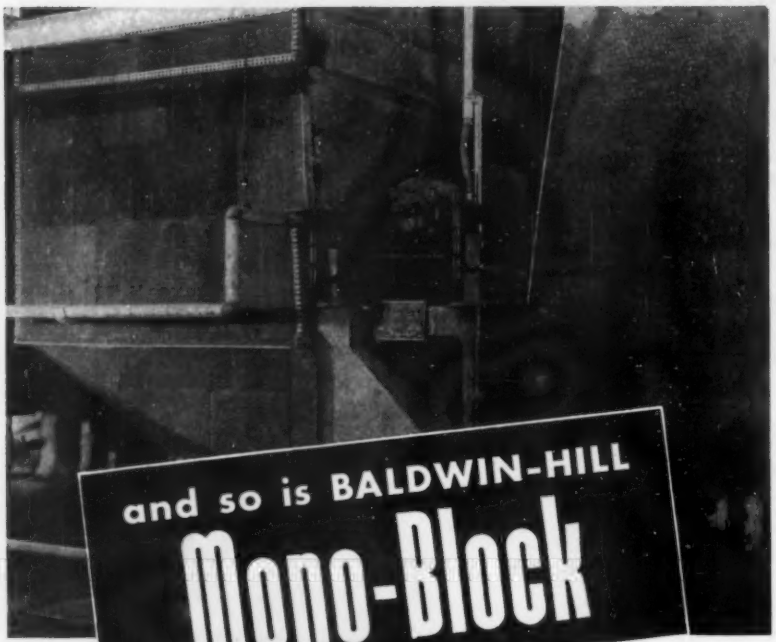
Johnson Thermostats on one of the central fan air conditioning units regulate the fresh air supply and control the temperature of the conditioned air. The thermostatically controlled steam valve provides a constant discharge temperature in the heating season.

JOHNSON CONTROL

TEMPERATURE ⇅ AIR CONDITIONING

MANUFACTURING • PLANNING • INSTALLING • SINCE 1885

Power is a problem solver

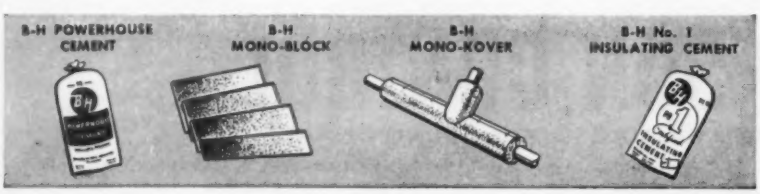


THE ONE-BLOCK INSULATION FOR TEMPERATURES UP TO 1700°F

- One Block application instead of two.
- Light in weight, easily cut with a knife to fit odd shapes.
- Impales over studs, clips, or wires.
- Low thermal conductivity because of unique felted structure.
- Forms strong bond with insulating cements.

Baldwin-Hill COMPANY
111 BREUNIG AVE., TRENTON, N. J.
Kalamazoo, Mich. • Huntington, Ind. • Temple, Tex.

Send for bulletin with data on composition, properties, efficiency and low applied cost.



More EQUIPMENT NEWS

Begins on page 160

pumps was developed to meet four specific requirements of continuous reactors: precise proportioning of feed streams, centralized control of process pumps, independent and automatic control of catalyst feed, and integral operations monitor and warning system. Process capacity can be regulated by adjustment of a single handwheel mounted on front of panel. Any process pump can be cut by a panel switch.

Milton Roy Co, Station V, 1300 E Mermaid Lane, Philadelphia 18, Pa.

Aluminum cable adapter

1162 • Standard copper-alloy connectors provided in electrical apparatus are designed for copper conductors and do not have the characteristics required when aluminum is used. Made from tin-plated copper alloy, this adapter is designed to combine good electrical conductivity with springiness. It has a round barrel from which extends a smaller, split cylinder called a tang. Barrel fits on the cable and the tang is inserted under equipment clamp. When clamped, the adapter's legs are squeezed together like cantilever springs.

Cleaning action was built into the new connector to combat aluminum oxide's high electrical resistance. The adapter is installed by forcing it on the cable with pliers or a hammer. Adapter-cable assembly is then inserted under the equipment clamp.

Manufacturer recommends the adapter for meter enclosures, other enclosed electrical terminal connections and for connecting cable to exposed pole-line equipment, such as transformers.

The Thomas & Betts Co, Elizabeth, N. J.

For more data on these items, use post cards p 169. Identify your request with item number.

Continuous level indicator

1163 • Explosion-proof electronic level indicators are designed for National Electrical Code Class I, Group C and D, and Class II, Group E, F and G operations. Units are available in several combinations suitable for many industrial and laboratory applications. They employ the standard *Telstor* continuous level indicator, a one-tube electronic unit for measuring mass or level of liquids, viscous fluids, powders and granular

When something's got to give
to compensate for expansion,
contraction, vibration, rotation or strain,
in your piping system or equipment,
it will be far, far better for you
if the "something" that gives
is a Zallea Expansion Joint
and not your expensive piping.
Since piping damage usually
means down-time, it pays
to provide positive, over-all protection.

The expansion joints illustrated,
duo-equalizing, hinged, and universal,
are just a few of the Zallea family
of expansion joints available
to help solve your piping problems.

Regardless of piping movement,
whether axial, lateral, rotational,
etc., Zallea already has, or will
design, an expansion joint to absorb it.
For information on standard types,
request Bulletin 351. For consultation
on special problems, ask us to
have our representative call.

Zallea
expansion joints

ZALLEA BROTHERS, 814 LOCUST ST., WILMINGTON 99, DEL.

World's Largest Manufacturers of Expansion Joints

HERE is the ideal CHECK VALVE for tanks and other vessels

When used with tanks (as shown here), dry cans, retorts and pressure vessels of all kinds, the DURABLA Check Valve Unit is the lowest cost, high-quality valve you can buy.

LOW COST—The cost is low because all you buy are the working parts. The vessel wall acts as the valve body.

HIGH QUALITY—Made of stainless steel (or a combination of stainless steel and Ni-resist), these valves will handle practically any liquid, gas or air—at all temperatures and pressures. They will operate in any position.

DURABLA Check Valves are available in seven standard line sizes, from ⅜" to 2". Ask your distributor for complete information or write us direct for bulletin P-1. DM-15

DURABLA

DURABLA MANUFACTURING COMPANY

114 Liberty Street, New York 6, N. Y.

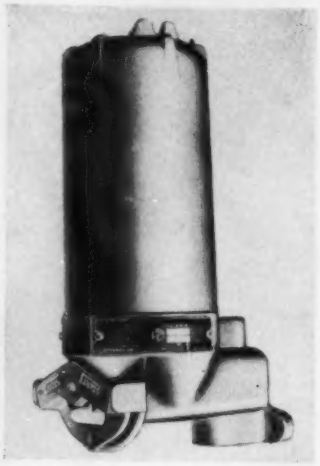
Visit our exhibit, Booth 700, National Power Show, Philadelphia, December 2, 3, 4, 6, 7

More EQUIPMENT NEWS

Begins on page 160

solids, regardless of whether they are conducting or non-conducting. The *Telstor* contains no moving parts that might clog or cause inaccuracies.

Fielden Instrument Division, Robertshaw-Fulton Controls Co, 2920 N 4th St, Philadelphia 33, Pa.

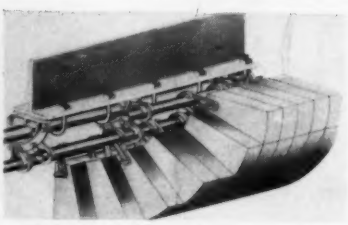


Push-button station condulet restarts motors automatically

1149 • Time delay push-button station condulet *type OFC* is set to restart motors within time limits of 2, 4 or 6 seconds. Explosion-proof, dust-tight device is designed for Class I, Group D; Class II, Groups E, F, G; or Class III hazardous locations. Interior electrical equipment includes push-button switch, capacitor, rectifier, sensitive relay and control relay. A transformer for voltages exceeding 110 is supplied, with capacities of 220, 440 and 550 volts. Complete data on request.

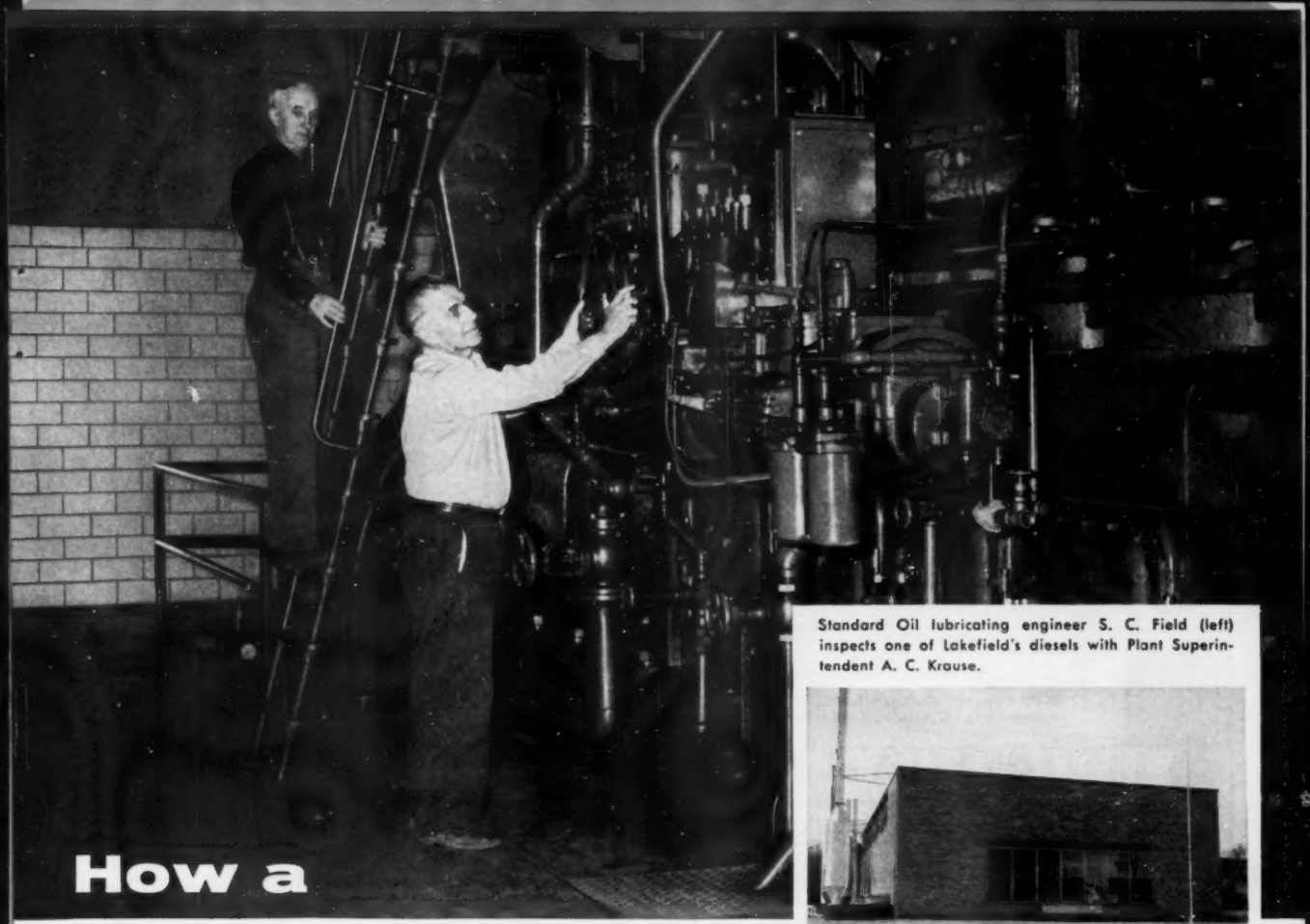
Crouse-Hinds Company Wolf & 7th N Sts, Syracuse, N. Y.

For more data on these items, use post cards p 169. Identify your request with item number.

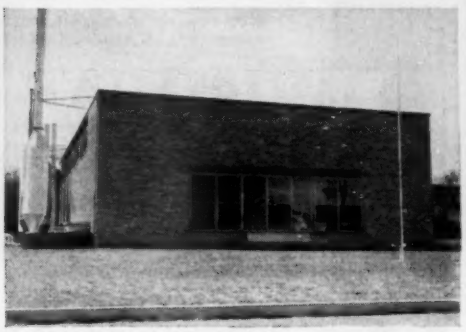


Free-moving refractory tiles

1164 • New type casting design for fantail nosing in open hearth furnaces provides for expansion of refractory tiles in all directions. Design utilizes arcuate castings placed on steel tubes that are suspended from steelwork with U-bolts. Arcuate castings are not bolted to supporting steel but have freedom for movement horizontally should horizontal expansion of tiles occur. Manufacturer claims that since all castings are free to move horizontally, erection of nosing is a fast and simple procedure; oversize or undersize tiles are easily com-



Standard Oil lubricating engineer S. C. Field (left) inspects one of Lakefield's diesels with Plant Superintendent A. C. Krause.



How a "sightseeing" tour solved our lubrication problem!

• A few years ago the diesels supplying power for the Public Utilities Plant, Lakefield, Minn. needed frequent cleaning and overhauling and still did not operate at rated capacity. Ring-sticking and deposits were persistent. Several oil switches failed to make any improvement.

Then a Standard Oil lubrication engineer took the Lakefield superintendent on a visit to other nearby plants where similar problems had been successfully licked. In these plants all engines were running on STANDARD HD Oil. In all cases rings were found to be free—deposits completely absent.

Soon after this "sightseeing" tour, one of the Lakefield engines was test-run on STANDARD HD. In less than six months it was thoroughly cleaned up and running at rated capacity. Naturally, Lakefield's other diesels were all switched to STANDARD HD Oil soon after and have been running trouble-free ever since.

If you've got a lubrication problem and would like to see how other plants licked the same kind of trouble, check with your nearest Standard office. Or write to Standard Oil Company, 910 S. Michigan Ave., Chicago, Illinois.

STANDARD HD
TRADE MARK
OIL

STANDARD HD Oil keeps engines running better. It's specially made to minimize wear in vital operating parts . . . keeps engines operating at peak efficiency by keeping engines clean. Try some today and see why more and more midwest plants are running better on STANDARD HD Oil.

STANDARD OIL COMPANY **STANDARD** *(Indiana)*

Choose WESTERN
for Chemical Treatment of Water, Steam and Fuel

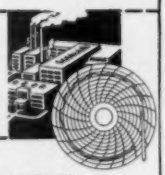
Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

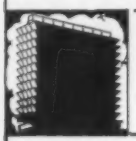
1 *Steam* + CORAVOL® = *Protection* (FROM CORROSION)

CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

2 WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.





3 COOLING WATER TREATMENT AND ALGAECIDE

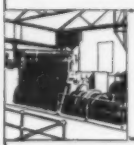
Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

4 BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

5 WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.



6 WESTERN LIGHTNING TREATMENT

Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

7 WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

8 WESTERN SOOT REMOVER

Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

9 WESTERN FUEL OIL SLUDGE DISPERSANT

Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.

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More EQUIPMENT NEWS

Begins on page 160

pensated for by shifting or sliding castings on the tubes from which they are suspended. Shearing of castings is eliminated and mechanical spalling of refractories, whether clay or basic, is greatly reduced.

Geo P Reintjes Company, 2517 Jefferson St, Kansas City, Mo.

Visual liquid level check for pressure-sealed systems

1165 • *Level eye* checks inside pressure-sealed systems for liquid level, gas-liquid ratio, cleanliness of liquid, operation of sealed valves and linkages. Suitable for tanks or piping systems from –50 to 250 F and up to 300 psig.

Basically a heat-tempered glass lens with a series of concentric reflecting prisms on the liquid side of the glass, the *eye* reflects light where there is no liquid, while liquid behind the glass makes it appear black. If there is a wide variation in liquid level, several units can be mounted in vertical series. Transparent lens is also available.

H A Phillips Co, 3255 W Carroll Ave, Chicago, Illinois

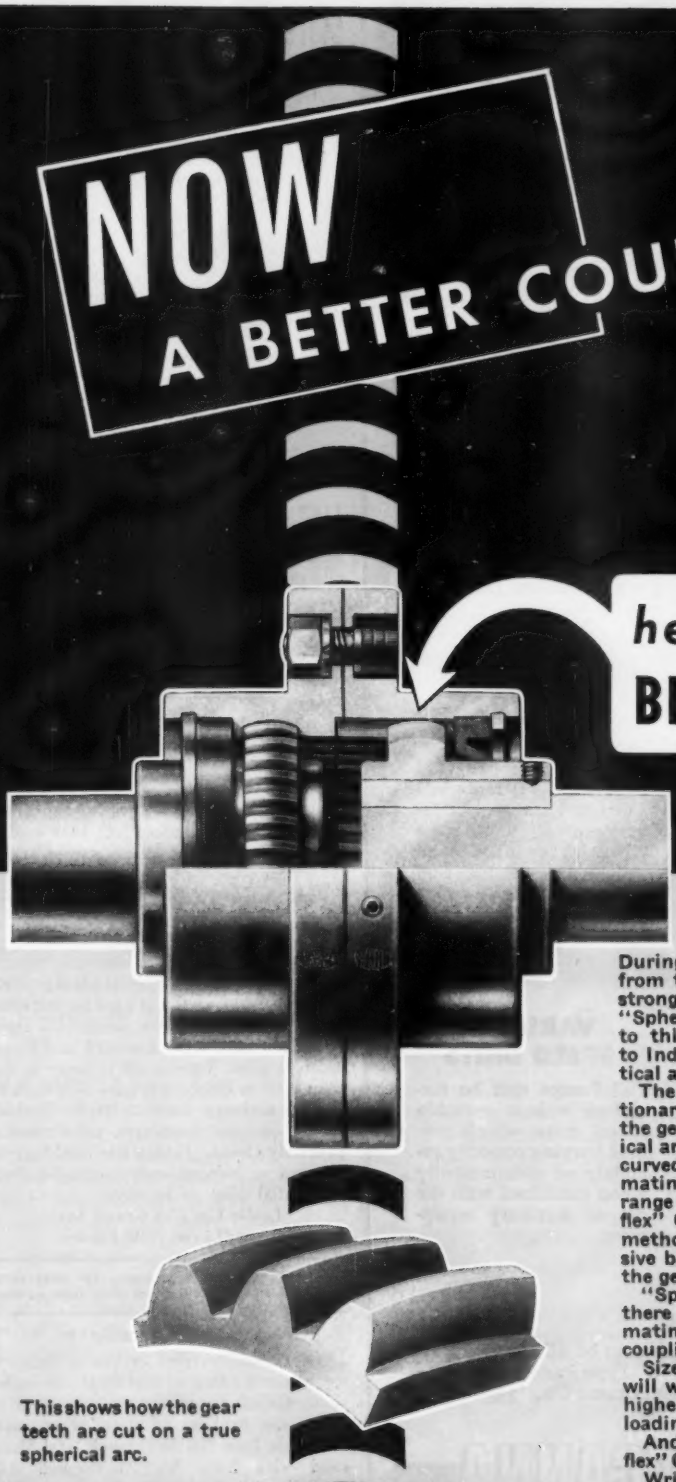
For more data on these items, use post cards p 169. Identify your request with item number.

Horizontal unit heaters

1166 • Propeller-fan unit heaters have low outlet temperature at standard 2 psig rating making them suitable for comfort heating jobs where high temperature, high pressure steam is used. Units can be used on steam systems to 125 psig. Capacities range from 385 to 5430 cfm (70 F air), 17,400 to 228,000 Btu/hr (with 60 F entering air and 2 psi steam pressure). Units are suitable without modification, for forced hot

NOW A BETTER COUPLING SPHEREFLEX

here's the BIG DIFFERENCE



This shows how the gear teeth are cut on a true spherical arc.

During recent years there has been a demand from the Aircraft Industry for a more flexible, stronger Gear Coupling. Although Philadelphia "Sphereflex" Coupling was developed in answer to this special need, it is now being offered to Industry in a complete line of standard, vertical and floating shaft couplings.

The "Sphereflex" Coupling utilizes a revolutionary new principle of coupling design, in that the gear teeth are precision cut on a true spherical arc. Since even the root of the gear tooth is curved, there can be no interference between mating gear teeth, even when shaft deflections range up to 7° total mis-alignment. The "Sphereflex" Coupling is in radical contrast to former methods of obtaining flexibility through excessive backlash or merely chamfering the tips of the gear teeth.

"Sphereflex" is a stronger coupling, because there is always a full line of contact between mating gear teeth, regardless of whether the coupling is flexed or perfectly aligned.

Size for size, the new "Sphereflex" Coupling will withstand more deflection, greater torque, higher rotating speeds, and more severe shock-loading than comparable couplings.

And remember, you pay no more for a "Sphereflex" Coupling than other good quality couplings.

Write for Catalog C-540.

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
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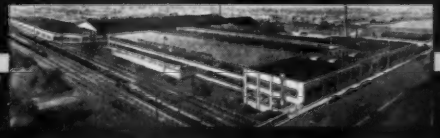
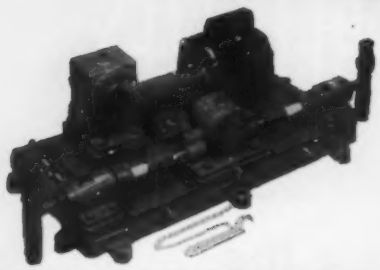


Industrial Gears & Speed Reducers

LimiTorque Valve Controls

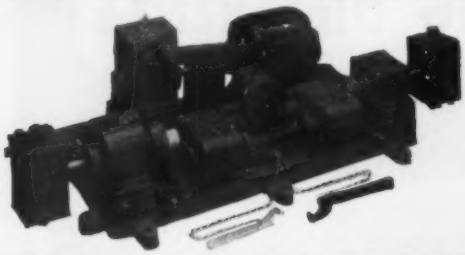
If you meter or proportion small volume flows...

THERE IS A HILLS-McCANNA "U" TYPE PUMP TO DO THE JOB



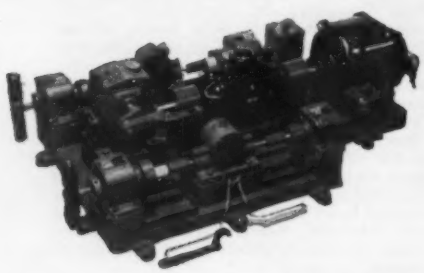
STANDARD 1, 2, 3 or 4 FEED UNITS

Standard "U" Pumps are available in maximum capacities from 0.10 to 24.0 gal. per hr. per feed. Operating pressures from 125 to 5000 psi.



JACKETED UNITS

For handling materials that require heat or refrigeration, "U" Pumps can be supplied with either or both jacketed liquid ends and check valves.



VARIABLE SPEED UNITS

"U" Pumps can be furnished with a variable speed drive which permits varying capacity remotely or automatically when combined with the proper auxiliary equipment.

Write for Catalog:

Catalog UP-52R gives full data on all sizes and types of Hills-McCanna "U" Type Pumps. Write for a copy, today. Hills-McCanna Co., 2369 W. Nelson St., Chicago 18, Ill.

HILLS-McCANNA

metering and proportioning pumps

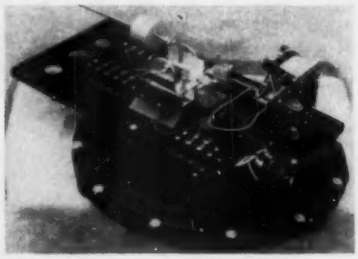
Also Manufacturers of:
SAUNDERS TYPE DIAPHRAGM VALVES
FORCE FEED LUBRICATORS • MAGNESIUM ALLOY SAND CASTINGS

More EQUIPMENT NEWS

Begins on page 160

water heating systems. Available with single or two-speed motors. Request bulletin 700-A5 for complete information.

Herman Nelson Products, American Air Filter Co, Inc, Louisville, Ky.



Damper control units

1167 • Electrically operated damper control regulates overfire draft in boiler combustion chamber fired by fully automatic oil, gas or coal burning equipment. Fuel saving features, according to manufacturer, include closed stack damper during burner shutoff period and draft regulated to ± .01-in. WG during operation. *Type AAP* may be used universally to control draft. *Type AALP*, specially adapted for use with induced draft, features low draft limit switch to insure shutoff of burner equipment if draft drops below an adjustable minimum.

Power unit, rated to overcome torque of about 500 in.-lbs, moves dampers readily, even after dirt accumulations have greatly increased their drag, manufacturer states.

The Nichols Instruments Co, 1115 N Hunter St, Baltimore 2, Md.

Floatless level control

1168 • Manufacturer claims unit assures constant water level in boiler plant condensate return tanks, without need for manholes or access into tank. Tap connections above and below tank water line lead to differential type pilot. Varying air pressure is sent from pilot to diaphragm valve that controls flow of make-up water to tank. Without air pressure on diaphragm, valve remains positively closed. Tank water level may be changed or independently controlled from differential pilot as required.

Leslie Co, 235 Grant Ave, Lyndhurst, New Jersey

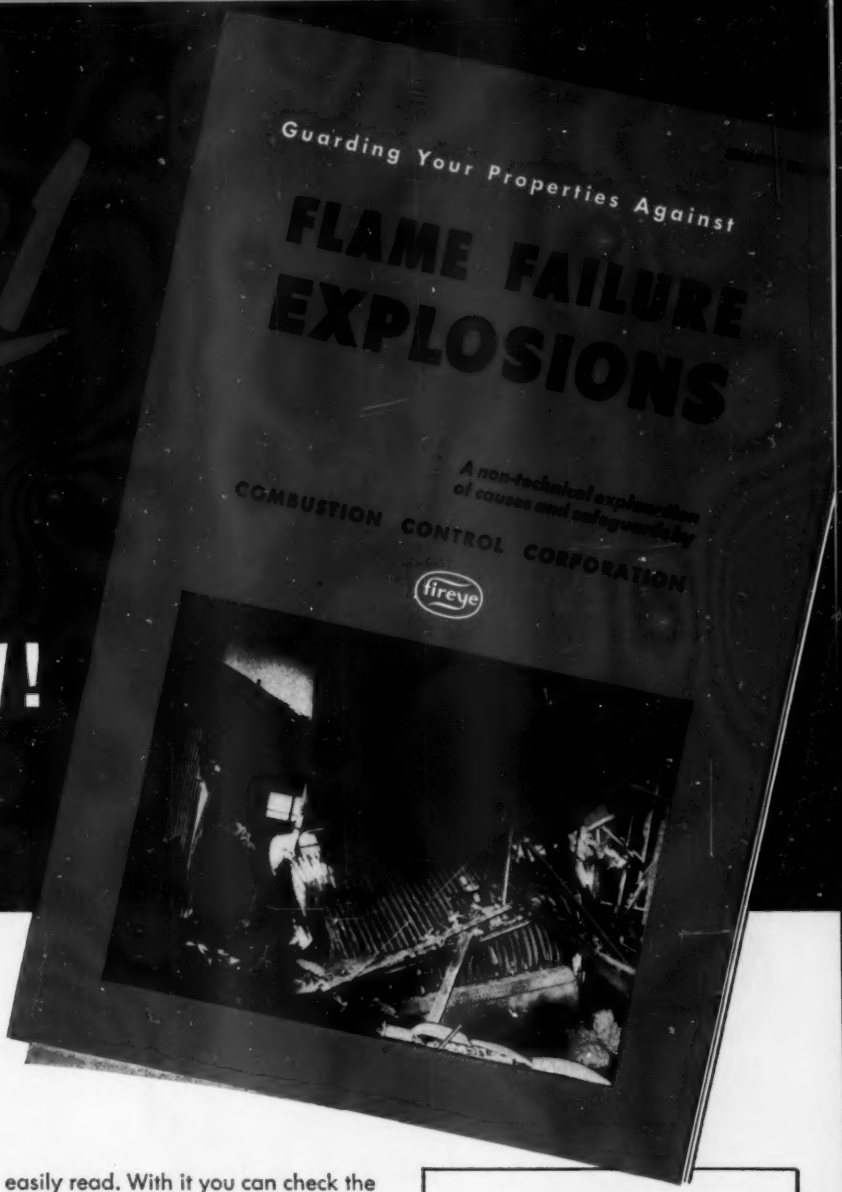
For more data on these items, use post cards p 169. Identify your request with item number.

Pocket-size caliper

1148 • Stainless steel caliper is designed for direct reading of electrical conductor sizes. Called *Wire-Mike*, instrument gives direct size readings of stranded commercial cable from No. 18 through 2000 Mcm, solid wire from No. 20 through 4/0 (AWG); ACSR from No. 6 through 336.4 Mcm, rigid conduit and copper pipe from ¼ through 2½ in., and thinwall conduit from ⅜ through 2-in. Weighs 2 oz, with overall closed length of 4½ in. Includes conversion table of pipe sizes to inside dimensions. Full details on request.

Burndy Engineering Co, Inc, Norwalk, Connecticut

It's 4-to-1 you need to read this booklet NOW!



Records show the chances are 4-to-1 you are NOT protected against explosion hazard, if you burn fuel for heat, power, or processing.

WHEN A BURNER flame fails without instant cut-off of fuel, an explosive mixture collects . . . and may ignite disastrously on hot firebricks. A delay of only 30 seconds can spell tragedy, yet most "safeguards" in use today simply do not act that fast!

What can you do for proper protection . . . ?

You can do a great deal, easily, inexpensively. First, send for this free booklet. "Guarding Your Properties Against Flame-Failure Explosions" is a primer on such hazards, quickly and easily read. With it you can check the protection you now have, and determine the protection you really need. Money-wise it could prove to be the most important booklet you've ever read.

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Fire insurance records show that flame-failure explosions happen regularly . . . and **they are costly.** Consider that your properties may be next, and mail the coupon *now!*

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It has been compiled by the pioneers of *instant* electronic flame-failure protection. Long experience in the research and manufacturing of Fireye Flame-Failure Safeguards makes Combustion Control Corporation the one company best qualified to write on this subject . . . and the one company who can offer you Firetron — the flame-failure sensitive cell that's unrivaled for dependability.

FIRST and FOREMOST IN INSTANT FLAME-FAILURE PROTECTION

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Dept. C9-11, 718 Beacon Street, Boston, Mass.

Please send me your FREE booklet, "Guarding Your Properties Against Flame-Failure Explosions".

Name .....

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BIDDLE *Instrument News*

MOTOR and PHASE ROTATION TESTER

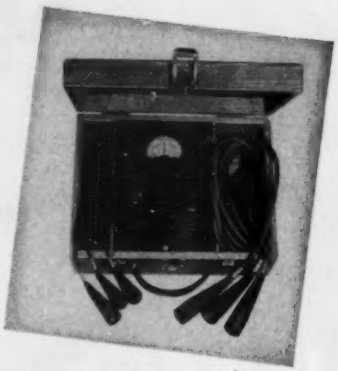
A Dual Purpose Instrument

For determining:

. . . Direction of rotation of electric motors before they are connected to the line.

. . . The phase rotation or sequence of energized power circuits.

Here is a positive means for determining which motor leads must be connected to certain conductors of a supply system to insure that the motor will rotate in a prescribed direction when energized.



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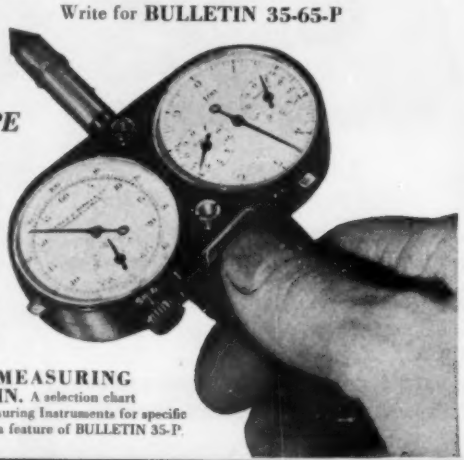
FAMOUS Dr. HORN *HAND TACHOMETER*

Many consider Dr. Horn to be the finest speed measuring device obtainable. Gives instantaneous readings of rotational—or linear and peripheral speeds—regardless of the direction of rotation. Measures 6 ranges from 25 rpm to 30,000 rpm. Operates with equal precision in vertical, horizontal or slanting position. Simple mechanism. Overspeed protection. Low maintenance. Long life. James G. Biddle Co. is sole U.S. distributor.

Write for **BULLETIN 35-65-P**

TWO-IN-ONE JAGABI® *TACHOSCOPE*

Combines speed indicator and stop watch. Replaces "human element" of error in starting and stopping with higher accuracy of calculation because Tachoscope can be operated for longer period. High precision instrument for measuring machine speeds up to 20,000 rpm. Frequently used as a standard for checking other speed measuring instruments. The high quality stop watch may also be used independently.



SPEED MEASURING BULLETIN. A selection chart of Speed Measuring Instruments for specific conditions is a feature of BULLETIN 35-P.

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Please send me material checked:

☐ 80-P ☐ 35-65-P ☐ 35-P

NAME

JOB FUNCTION

COMPANY

ADDRESS

MARMADUKE

Continued from page 148

"We all sat cross-legged on thick oriental rugs around a low banquet table. Bladenberg sat on the Sultan's right, I on his left. He kept stuffing his face with goat, washing it down with drain cleaner and belching a blast every few minutes. He sounded like the glue factory's old Number 2 boiler lifting her safeties. Belching was a sign that you enjoyed the meal and before long everyone else got into the act.

"Bladenberg had tipped me off to do whatever our host did, so the two of us joined in stowing away fuel and lifting our safeties like the rest. I've taken on plenty of bunkers in my day, but, by the time we had battened down our hatches for the evening, it looked like we'd have to be hoisted from that rug with a steam-cargo winch.

"The Sultan informed us that next day he'd take us aboard his new diesel yacht. Only we discovered that she wasn't new and she wasn't a yacht. Looked more like an old flat-bottomed oil barge that had been painted and had a canopy built over her. She had a 100-hp Russian diesel engine down in a hold at her stern end.

"We started for a trip of about 20 miles across one corner of Lake Kebzu. The party of the evening before was aboard, including some of the servants. This was to be a sight-seeing trip with eating and drinking thrown in for good measure.

"The barge skipper must have been showing off because I noticed from the engine's sound that she was wide open. I looked down the hatch and got a glimpse of his fuel-oil tank. It didn't look too large and I wondered if he had another one filled with oil, or if he expected to refuel across the lake.

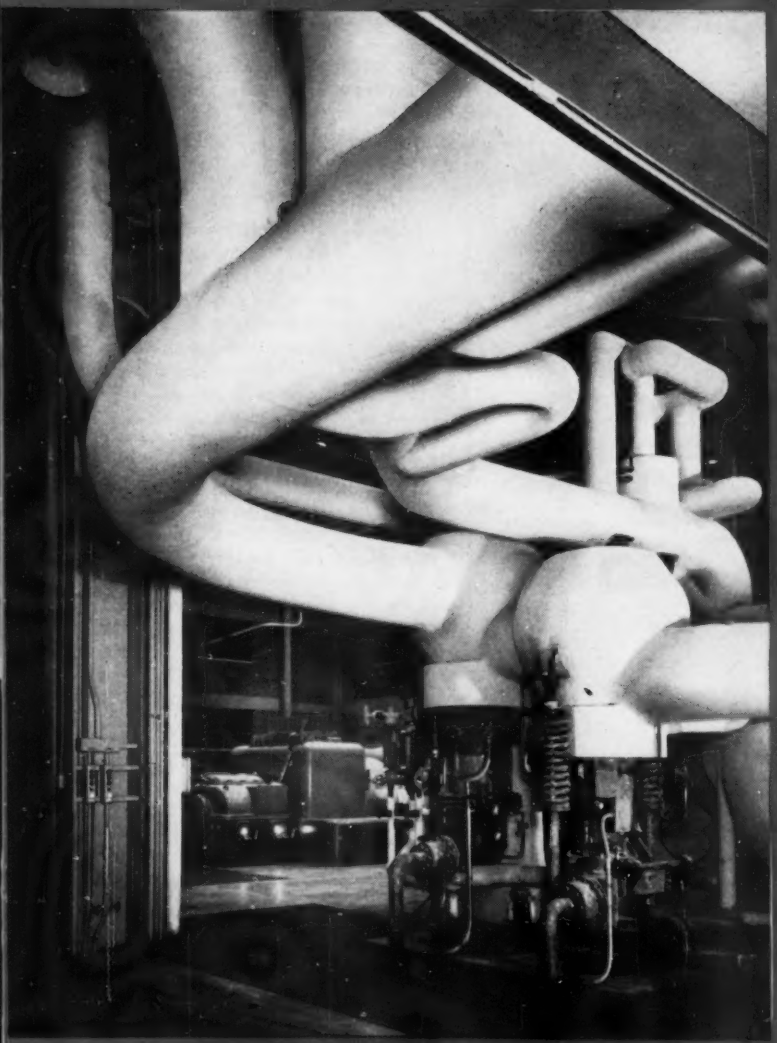
"One of the Sultan's English-speaking mouthpieces, who had been in the States, told Bladenberg that he hoped we were enjoying the trip after our long journey across the ocean and up the mountains. When the boss asked why, he told him he knew we wouldn't get to first base when we talked oil with the Sultan.

"'Why not?'" asked Bladenberg.

"'Because the Sultan believes that our god Shazar gave us the oil since only we know what to do with it. And for the time being the Sultan chooses to leave it in the ground,' was the discouraging answer. I learned that the little oil needed in those parts was shipped down the Perak Sea from Russia.

"After crossing the lake, the kitchen mechanics pitched a big tent, spread the rug, and towed in the fuel and boiler compound. After two hours of ballasting we were bushed from the high liv-

What do you buy when you place a *Piping Contract?*



What you really buy is performance . . . and good value for your piping dollar. And how do you get these? By selecting a piping contractor who has a reputation for quality work . . . who is called upon to do job-after-job for the same customers. It's as simple as that.

Midwest is such a piping contractor. Midwest Piping is superior piping and good value for every piping dollar. We shall be happy to have you ask us to prove it.

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MIDWEST **PIPING FABRICATION and CONSTRUCTION**

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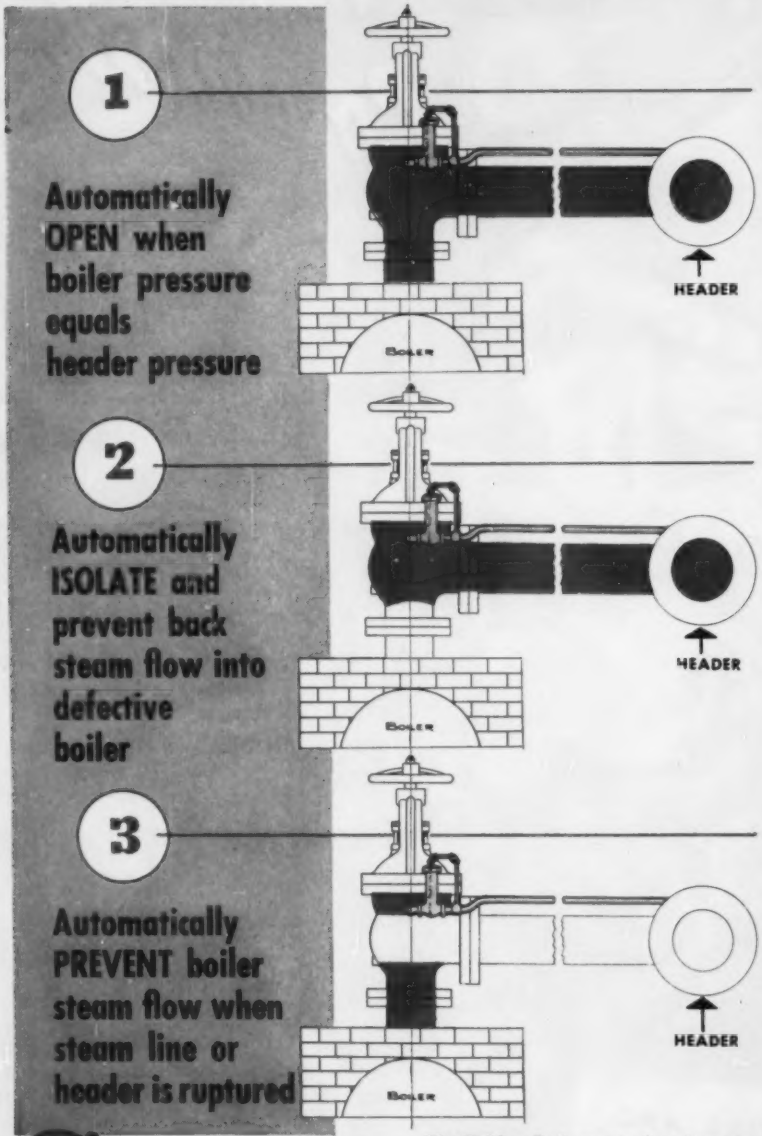
Golden-Anderson
CUSHIONED
Triple Acting Non-Return
VALVES
Control Boiler Steam Flow SAFELY


1
Automatically OPEN when boiler pressure equals header pressure
HEADER
2
Automatically ISOLATE and prevent back steam flow into defective boiler
HEADER
3
Automatically PREVENT boiler steam flow when steam line or header is ruptured
HEADER

The Golden-Anderson triple-acting non-return valve may be also used to control flow of air, gas or hot water. Bulletin S-1A gives complete details.

GOLDEN ANDERSON *Valve Specialty Company*

1241 RIDGE AVENUE, PITTSBURGH 33, PA.

DESIGNERS AND MANUFACTURERS OF:

Non-Return Valves • Altitude Valves • Solenoid Valves • Engine Stop Valves • Swing Check Valves
Float Valves • Pressure Reducing Valves • Surge Relief Valves for air, gas, steam and water

MARMADUKE

Continued from page 192

ing, so we piled back aboard the barge and headed for home. But I could see that Bladenberg wasn't too happy and knew he hadn't dreamed up any good arguments to get that oil lease. Everything else was OK until about ten miles from shore. Then the engine started sputtering and suddenly gave up the ghost.

"The worried engineer ran up to the skipper and the skipper hot-footed over to the Sultan. We had run out of fuel. The Sultan blew a gasket and it looked like both the skipper and engineer would be thrown over the side any minute. Just then I had a brain storm. I told the mouthpiece to tell the Sultan that next to Shazar I knew as much about oil as anyone. If I could inspect the engine I might bring the boat in. The Sultan closed his safety valve long enough to give me the green light.

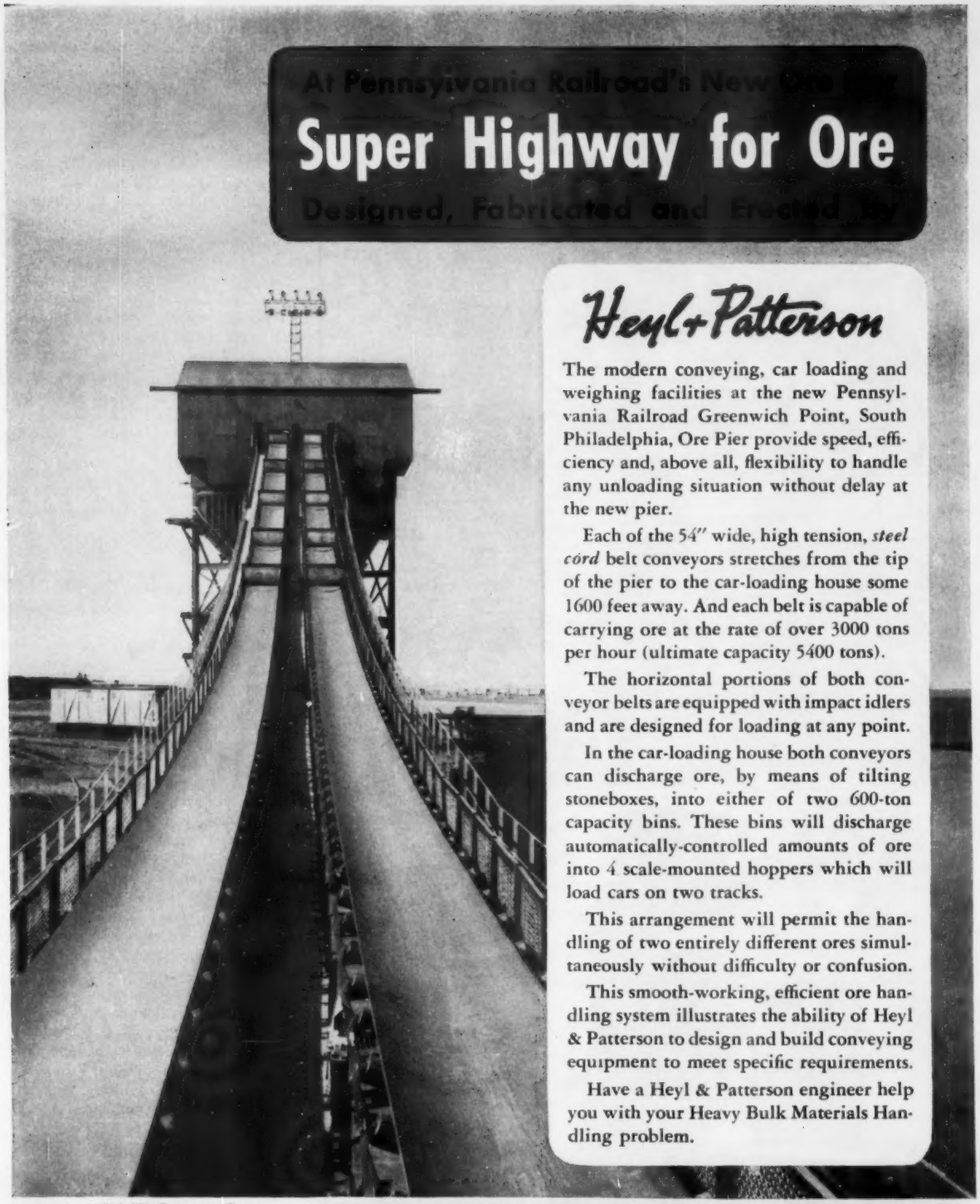
"I asked for a flashlight, then looked into the large flat-bottomed tank. After one squint I told Bladenberg that if things worked out as I planned, we'd go back to the States with the oil lease in our pocket—but he didn't get my pitch.

"While the Sultan and his buddies crowded around, I ordered his crew to tie rops to buckets, pitchers or anything they had and start heaving water over the side. I then ordered the engineer to pour the water into his fuel tank. He started raving, but one look from the Sultan and he obeyed.

"While this was going on, I pulled my large notebook from my pocket. It was filled with names, addresses and phone numbers of interesting people I did business with in ports around the globe. I held the book open before me with one hand. Then I held up a pitcher of water with the other hand. Idea was to act like I was praying for the water to be blessed. The Sultan and his party seemed mighty impressed. But I noticed Bladenberg eying me as if I had snapped a gusset stay from stowing away all that cargo, or something.

"After they had dumped about 20 gallons of water into the fuel tank, I had them stop. Then I informed the Sultan that in Shazar's eyes we Americans were mighty important because I had just had a message from him that he would pull a miracle by turning the water into oil.

"That was too much for the Sultan to swallow, and he bust out laughing violently. His stooges caught on and guffawed even louder. While they were busting at the seams, I walked calmly down to the engine and motioned for the Sultan to follow. With everyone else aboard staring down the hatch I opened the starting air-valve. As soon as



At Pennsylvania Railroad's New Ore Pier

Super Highway for Ore

Designed, Fabricated and Erected by

Heyl+Patterson

The modern conveying, car loading and weighing facilities at the new Pennsylvania Railroad Greenwich Point, South Philadelphia, Ore Pier provide speed, efficiency and, above all, flexibility to handle any unloading situation without delay at the new pier.

Each of the 54" wide, high tension, *steel cord* belt conveyors stretches from the tip of the pier to the car-loading house some 1600 feet away. And each belt is capable of carrying ore at the rate of over 3000 tons per hour (ultimate capacity 5400 tons).

The horizontal portions of both conveyor belts are equipped with impact idlers and are designed for loading at any point.

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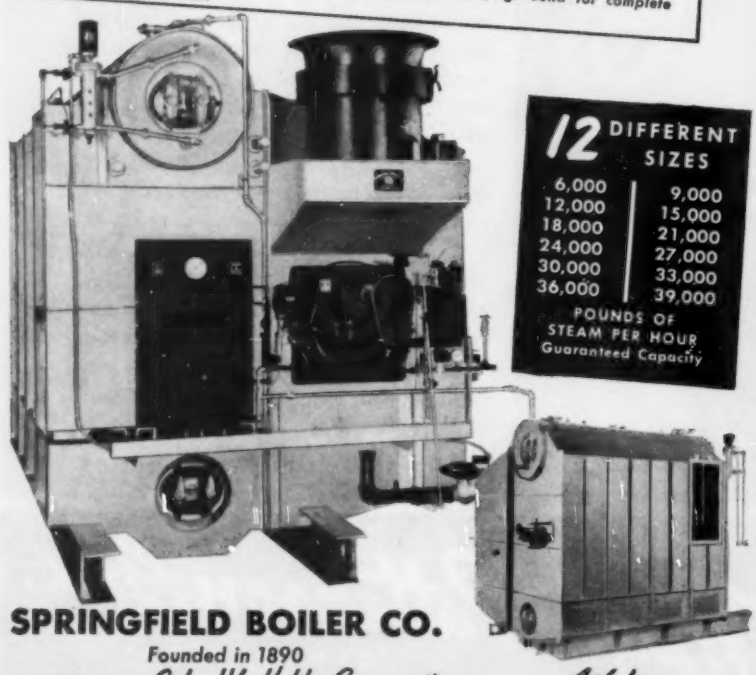

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MARMADUKE

Continued from page 194

the engine turned over a few times I cracked the fuel throttle. After a few revolutions the engine started firing with a roar. My audience, including Bladenberg, stood frozen in their tracks like statues. Then the Sultan yelled something excitedly and rushed up on deck.

"I kept the engine on slow speed because I knew fuel consumption is squared every time you double a boat's speed. And I knew I had to get in without fueling up on water again or my little trick would flop.

"When I got on deck the Sultan and his party were kneeling on their prayer rugs and praying like mad. When the praying was finished, the Sultan came toward me and Bladenberg, salaaming respectfully.

" 'You are the chosen ones in Shazar's eyes,' he informed us with reverence in his voice. 'I will be glad to make an agreement with your firm to take the oil out of the ground,' his interpreter translated."

With that, Marmy suddenly stopped talking and turned back to his unfinished business at the bar. We were all so lost in his story that we were spellbound. No one spoke for a few seconds.

"Say, Mr Surfaceblow," yelled a crusty old salt who had a patch over one eye. "How in hell did you get that engine started on water—that's what I'd like to know."

"How," roared Marmy, facing his admiring audience. "Why, by putting into practice what every farm boy knows if he's been around milk,—that's how. When I looked into that fuel-oil tank I could tell that the suction pipe stuck up from the bottom for about eight inches. I knew that was to keep sediment that settled out of the fuel from getting into the engine. But I also knew that oil floats on water. So all I had to do with that eight inches of oil was to lift it up by floating it on water."

With that he gave his old bowler a list to port, lit a new piece of rope yarn and went puffing out of the B P Bar in a trail of smoke like a coal-burning tramp ship headed for the South Seas.—*SME*

Marmy's Mailbox

I have been reading all the Marmy stories and the unusual situations he has gotten into since he came out in POWER—I enjoy him immensely.

J N WALTON *Philadelphia, Pa.*

Just read my new book, *The Marmaduke Story*. He is really quite a fascinating guy, and I shall always keep up with him in POWER.

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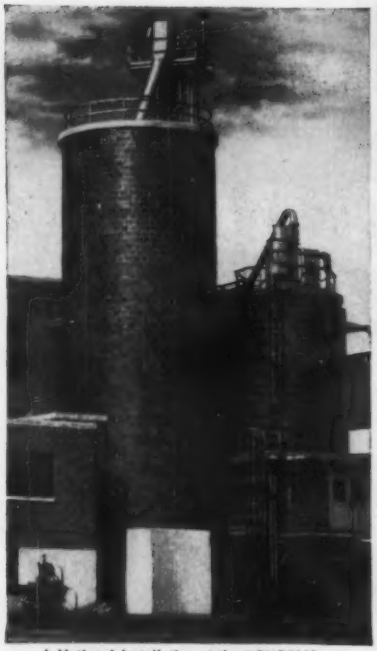

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NUCLEAR ENERGY

Continued from page 80

an isotope of beryllium. This reaction is sometimes used as a laboratory source of high-energy neutrons.

Neutron bombardment. Fig. 7 shows the important neutron reaction (n, γ) undergone by uranium-238 when bombarded by neutrons. After being bombarded and emitting gamma rays the product nucleus is the unstable uranium-239. The latter emits a beta particle to decay to neptunium-239, also unstable. This, in turn, also emits a beta particle to form plutonium-239. This element, which is not found in nature, is of vital importance as a fissionable material.

Gamma-ray bombardment. Although gamma rays lack the mass of particles, high-energy radiation of this type can cause nuclear reactions resulting in the release of protons or neutrons, Fig. 6. This type of reaction is often referred to as photodisintegration.

Extent of transmutations. During the past 20 years more than 700 different radioactive isotopes of all the known elements have been obtained by transmutation processes. In addition to the discovery of nuclear fission, the missing elements of atomic number 43 (technetium) and 61 (promethium), which are not known to occur in nature, have been isolated in radioactive form.

Eight elements beyond uranium in the periodic system (p 99, Aug 1954, POWER) have been prepared. They may once have existed in nature, but by now have decayed almost completely. These elements all lie beyond uranium in the periodic table and, therefore, are known as the transuranium elements. All have been obtained by artificial means and have atomic numbers beyond 92. Here is the list:

Atomic No.	*Element*	*Discovered*
93	Neptunium	1940
94	Plutonium	1941
95	Americium	1944
96	Curium	1944
97	Berkelium	1949
98	Californium	1950
99	—	1954
100	—	1954

One of the greatest contributions of the nuclear-energy program has been the manufacture of artificially radioactive isotopes by nuclear transmutation. Radioactivity of these materials is easily detected and acts as a "tag" or "label" that can be traced through any physical or chemical change. These *tracer elements* represent a powerful tool for the solution of numerous problems in biology, agriculture, medicine and industry in general.

The next installment will more closely examine the neutron and its reactions —in a forthcoming issue.

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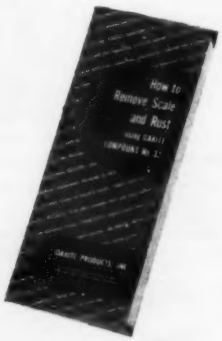

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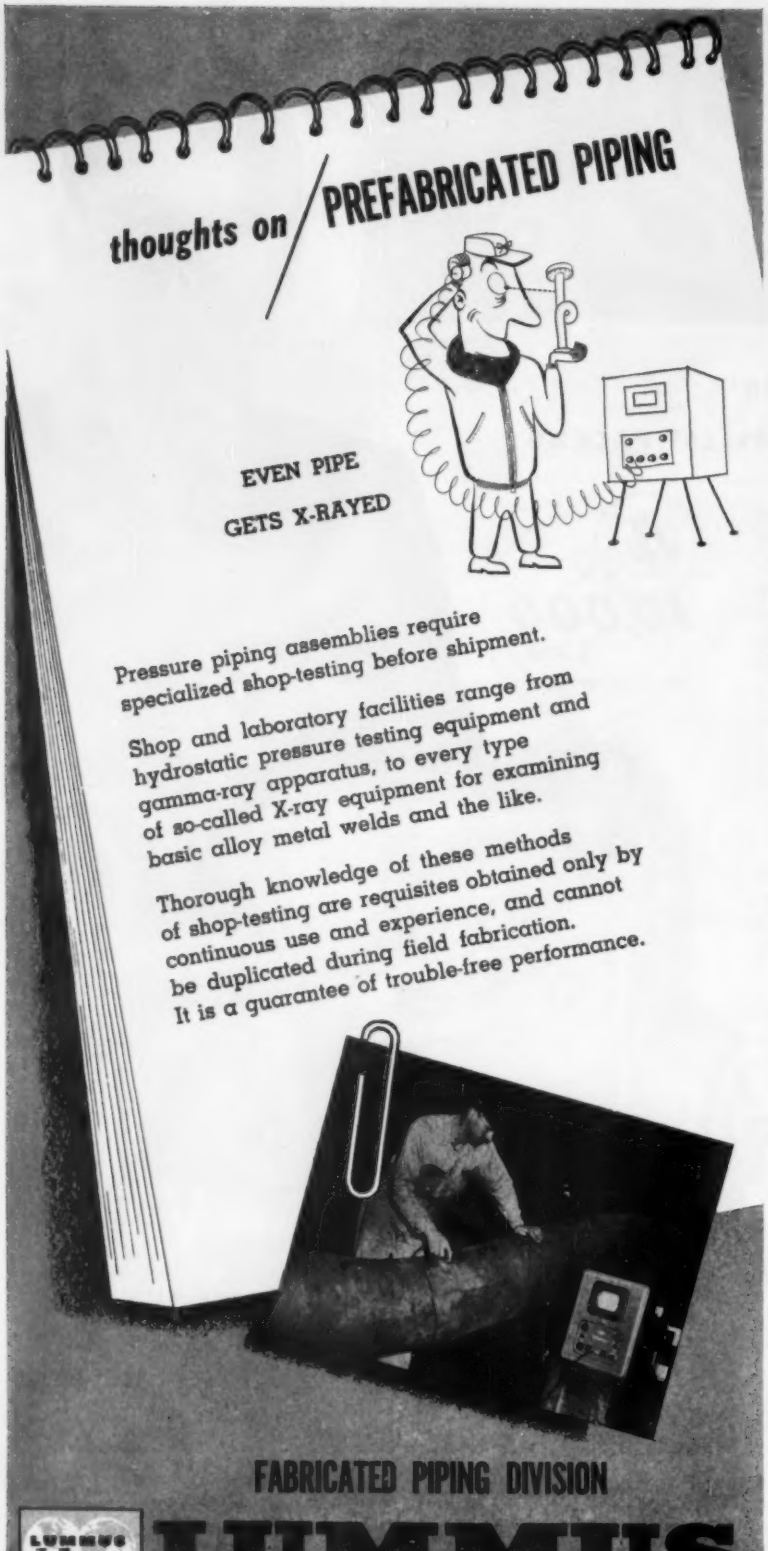
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BEST PERFORMANCE

Continued from page 99

nonretractable soot blowers are generally used. Steam to supply the multiple nozzles comes in to the blower element through a cam-operated valve arranged so blowing occurs only during the desired portions of the arc of rotation. For best operation, check cam settings, adjusting arc of blow if necessary so steam will not impinge on baffles or closely-adjacent boiler-pressure parts.

Because flue gas is hotter than boiler metal and soot-blower elements approach flue-gas temperature, elements need axial adjustment so blower nozzles discharge between boiler tubes even if element has lengthened slightly because of its higher temperature. Also, check to see that elements do not bind in their bearings or against boiler or setting parts as they rotate, under heated boiler and setting conditions.

Where steam is used for soot blowing, it may be taken from the boiler drum or from the superheater outlet if temperature there is not too high. Ordinarily, pressure is reduced somewhat in a reducing valve before steam passes to the soot-blower supply header. Orifices at the individual blower heads further reduce steam pressure to desired value, usually 100 to 200 psi.

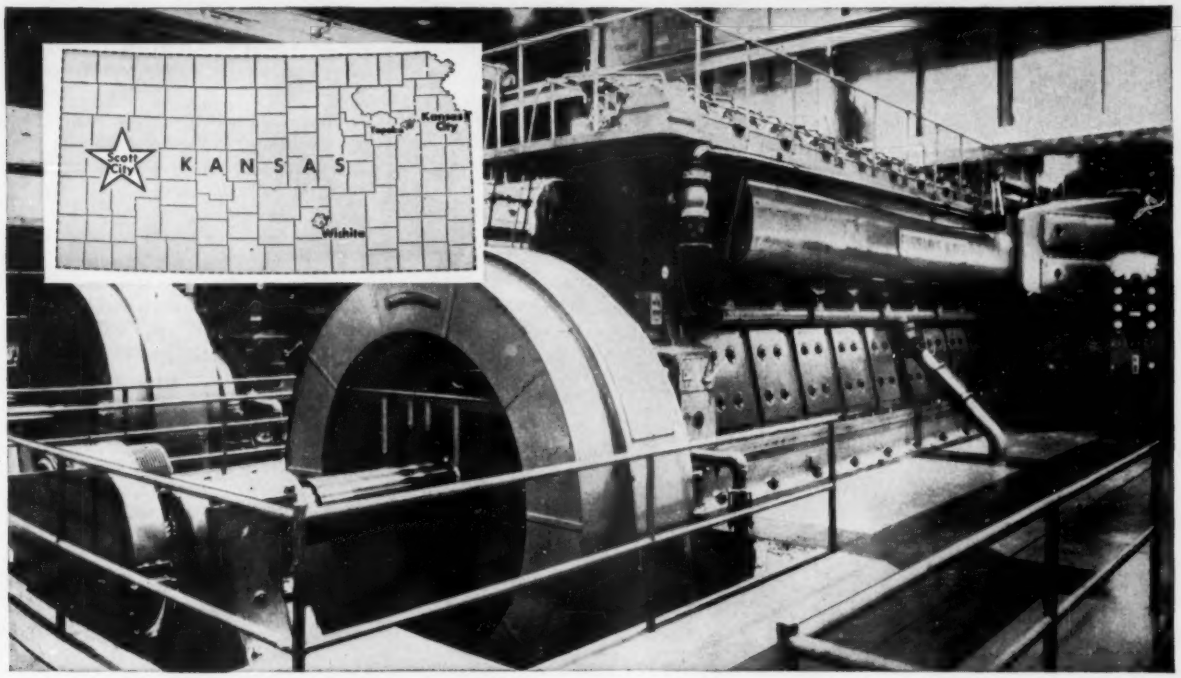
Check pressure at each blower during operation, and adjust orifice size to give recommended operating pressure for most effective and economical operation. Take care that heat content of steam supply is such that steam at the blower element is dry and preferably slightly superheated. Saturated steam above 800 psig may actually give moist steam at 200 psig.

Be sure soot-blower supply headers are well drained and laid out with ample flexibility so heating and cooling does not place a strain on the soot-blower heads. You need insulation on supply headers only where contact with the hot pipes might burn operators. If blowers are hand-operated and guided operating chains are used, they should extend to convenient operating locations and be plainly marked to facilitate blower identification.

Don't blow soot unless boiler is steaming at capacity of at least 30%. This precaution assures that fine ash and soot are rapidly carried out of the boiler, thus avoiding a possible explosive mixture of dust and air.

Before blowing, increase furnace draft to about 0.5 in. of water by increasing boiler draft and, if necessary, reducing incoming air slightly. The increased draft lessens possibility of dust or flame being blown out of inspection doors or other openings.

With regenerative-type air heaters,



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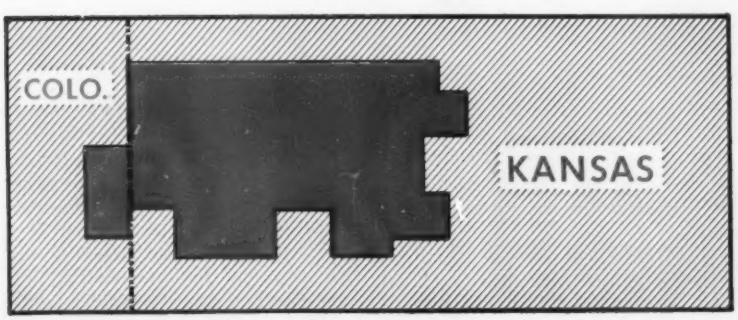

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BEST PERFORMANCE

Continued from page 200

loosened soot and dust are sometimes carried back into the burners with the air stream. This may tend to smother the fires, but increasing the air supply helps prevent it.

If you use air for soot blowing, cool it after compression to assure a dry supply to the blowers. Moisture in air or steam may cake the soot so it cannot be blown loose.

Precautions and procedures mentioned above for blowers using steam also apply for those using air, except that insulation, drainage and flexibility requirements are not so rigorous. Since draining the lines is not so essential or difficult, air is better adapted to automatic-control soot-blowing systems.

Retractable soot blowers. In furnaces and other high-temperature zones where a special-alloy fixed-position rotating soot-blower element will not withstand continuous exposure to the temperatures, retractable mass blowers of either long or short type are used.

Check these units for operation, travel and proper blowing angle before actually using them. If the element sticks or stops in a hot furnace, over-heating will probably ruin it, and adjustments will be difficult to make with the boiler in operation.

The mechanism for advancing and retracting the element may be steam-, air- or electrically-operated. Proper operation of switches and controls depends largely on protection from weather and dust and, with air, on a supply that is clean and dry.

On tubular air preheaters, soot blowers are uncommon. It is difficult to get satisfactory coverage of the surface. Moreover, you ordinarily get a deposit only when burning oil. If atomization in the burner is poor or if there is a considerable air deficiency, you may get a heavy coating of soot on the air-heater tubes. But if combustion conditions are kept right, scraping or blowing during periodic boiler outages should suffice. With other fuels, vertical preheater tubes do not usually require cleaning during operation.

Regenerative air preheaters generally need periodic soot blowing to keep the small passages between element plates clear and prevent excessive draft loss. If gas passages become plugged, uneven resistance to gas and air flow results, sometimes causing severe furnace pulsations. Frequent blowing prevents possible ignition of soot, with resultant damage to preheater.

You can use either a hand lance or a mechanically operated element to cover the complete revolving preheater rotor. Normally, blow in the same di-

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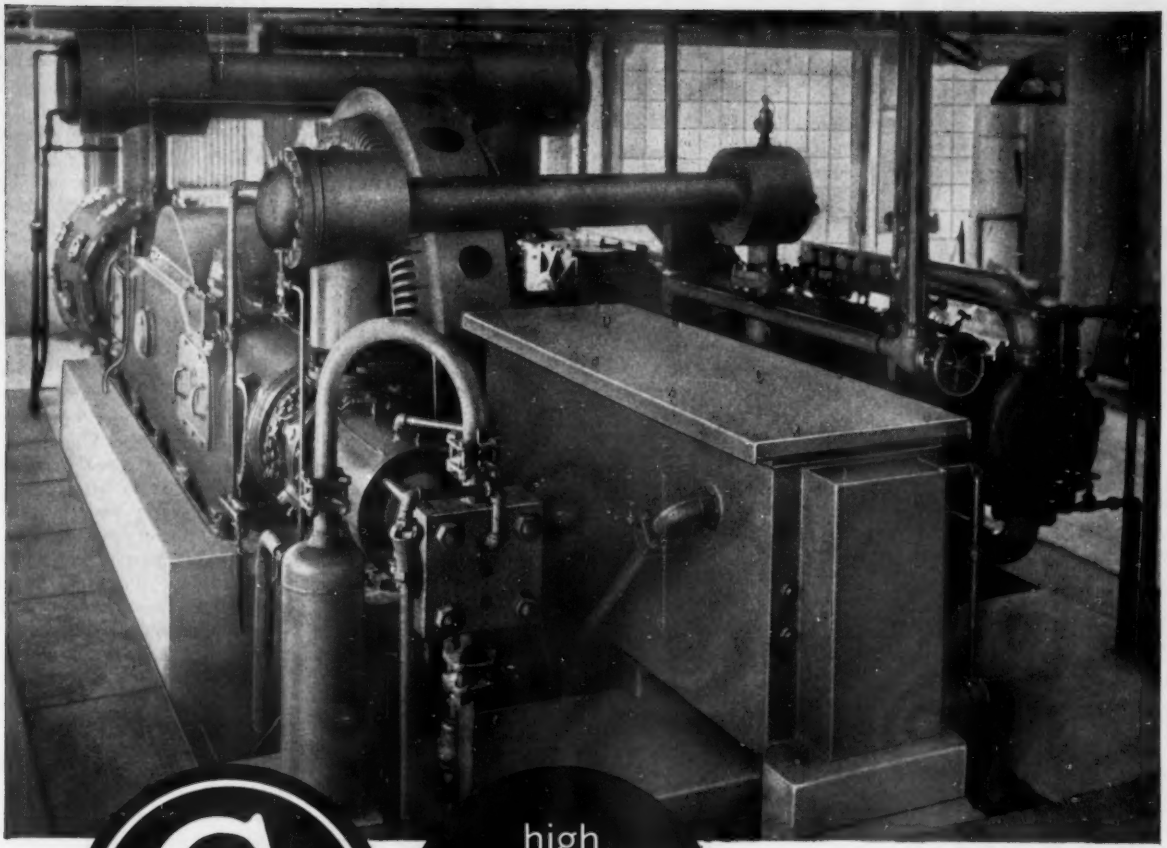

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BEST PERFORMANCE

Continued from page 202

rection as the air or gas flow, and usually on the air side, as deposits are heaviest on the cool end of the air heater.

Steam or air for blowing should be completely dry. Warm water has sometimes been used to wash preheater elements. This effectively softens sulfur-containing deposits left when burning oil or poor-quality coal.

Three factors that chiefly determine type and amount of deposits that accumulate on furnace, boiler, economizer and air-preheater surface are (1) type of fuel (2) rate of boiler operation and (3) completeness of combustion.

In high-temperature zones, regulate frequency of blowing to prevent slag accumulations heavy enough to raise furnace temperatures unduly, to restrict flue-gas passage at furnace exit, or to result in heavy formations that might break off and cause damage as they fall.

In cooler zones, schedule blowing to give best over-all economy, considering (1) effect of soot blowing on heat losses in flue gas leaving the steam-generating unit outlet, and (2) cost of steam or power for air used for soot blowing.

Order of blowing slag and soot blowers should follow the flue-gas path through the steam-generating unit. This avoids depositing dust on surfaces that have just been cleaned. Often two men, one on each side of the boiler, blow soot alternately to avoid traveling from one side of the unit to the other to operate blowers in proper sequence. A favorable sequence is assured, of course, if an automatic system is installed.

WITH OUR READERS

Continued from page 5

spotted it in the *Saturday Review*, illustrating an article titled "The Private Life of the Public Library." He was intrigued, of course, by seeing POWER pictured in a distinguished literary magazine, but was downright curious about what was clearly a Sept 1943 issue of POWER appearing in a 1954 article. So we went on a still hunt to dig out the origin of the photo.

Saturday Review editors didn't know much more about it than we did, but told us the photo came from the Tennessee State Library and Archives. Down in Tennessee, Martha Parks, Director, started some detective work for us and finally came up with the answers. The picture was taken in 1943, at Watts Bar Dam, in a library operated jointly by TVA and the Tennessee State Dept of Education's library division. We never did find out why this particular photo was selected to illustrate this particular article, but since it shows our favorite magazine being put to good use, can we afford to ask too many questions?—*Ed.*

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- **ASTM A-105 GRADE 2**

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These outstanding features are just what you've been looking for:

1. All parts are drop-forged of high quality steel for maximum strength and toughness to resist shock and vibration.
2. Heavy, octagonal-shaped walls give you added protection at high pressures.
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B

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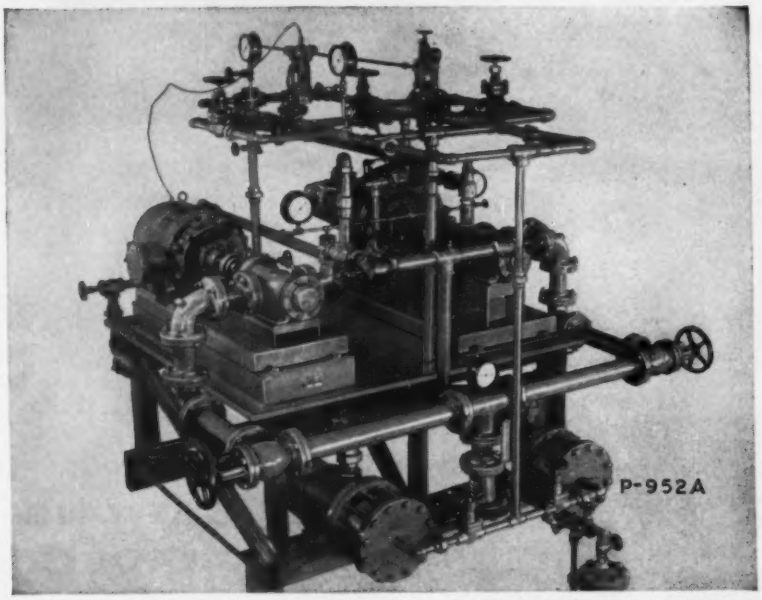

P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

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DESIGN ADVANCES

Continued from page 84

tion generation they produced.

The downward trend of average maintenance costs undoubtedly can be credited to the large number of new units coming into service. It may take several years before operating wear accumulates to the point where more maintenance activity is needed. On the other hand, this may not be a reasonable expectation. The growing size of individual units spreads maintenance dollars expended over a large number of kwhr and lowers the unit maintenance cost. In addition, we can expect that newer units will have improved design features that require less inspection and repair.

Fig. 4 (p 84) gives the frequency distribution curves of unit maintenance costs for each year from 1947 to 1953. In each year, the average maintenance cost is higher than the median cost (not shown) by a substantial margin. This is influenced by the large unit costs listed tabularly on each chart. In each year, stations with high maintenance costs are different, with a few exceptions. These high costs reflect a major overhaul performed during the year. Some plants, however, may not charge all the cost of a major repair to the year the work was done. They may arbitrarily spread it over several years. This has merit in that major overhauls often are the result of accumulated and deferred maintenance of several years' operation.

Pressure and temperature listed in Table I and II are the highest steam conditions used in the individual station. In some of the older stations, the older units may run with lower pressures and temperatures.

Here are the locations and owners of the stations appearing in the tables for the year 1953:

Kanawha River—Glasgow, W. Va.
Appalachian Electric Power Co

Tanners Creek—Lawrenceburg, Ind.
Indiana & Michigan Electric Co

Albany—near Albany, N. Y.
Niagara Mohawk Power Corp

Schiller—Portsmouth, N. H.
Public Service Co of New Hampshire

Dunkirk—Dunkirk, N. Y.
Niagara Mohawk Power Corp

J R Whiting—Erie, Mich.
Consumers Power Co

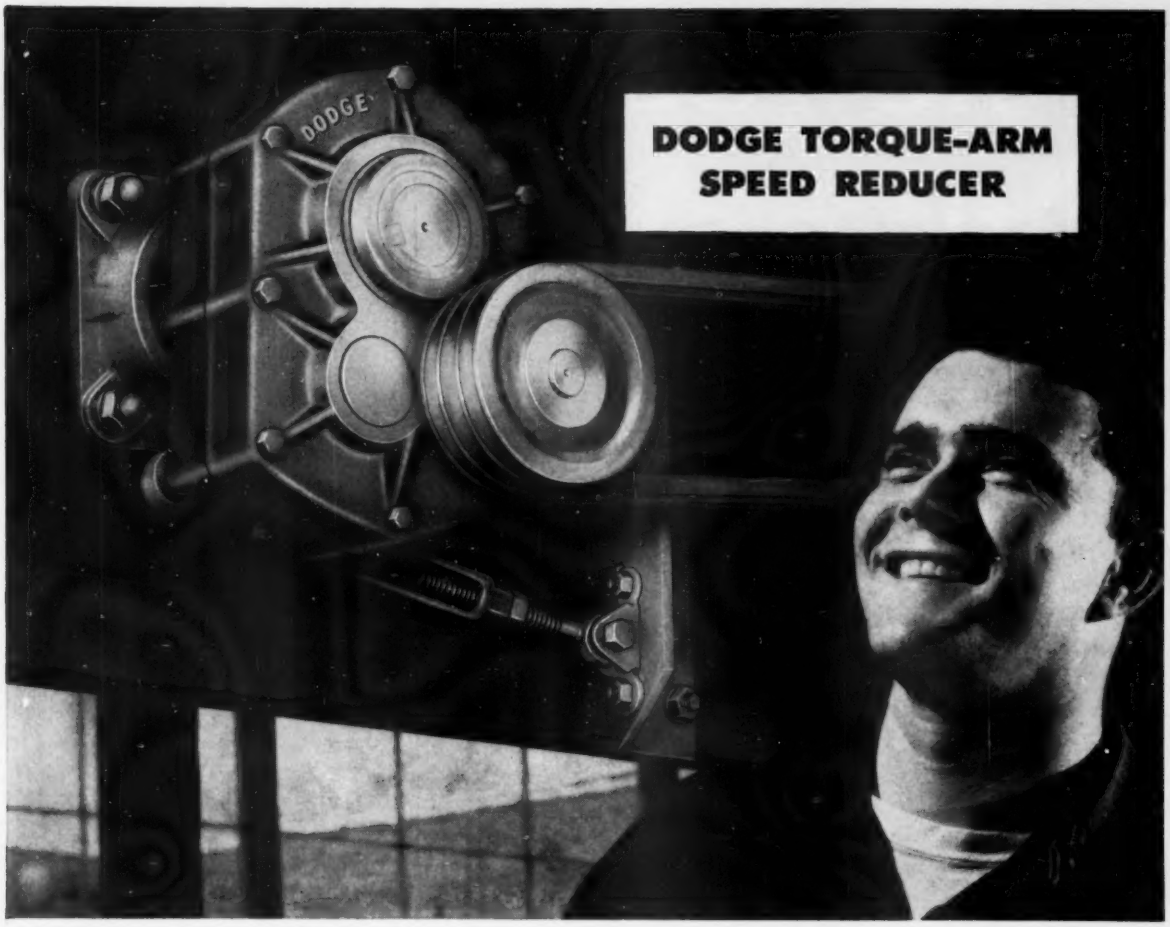
Philip Sporn—Graham Station, W. Va.
Appalachian Electric Power Co

St. Clair—East China Township, Mich.
The Detroit Edison Co

Eastlake—Eastlake, Ohio
Cleveland Electric Illuminating Co

Astoria—New York, N. Y.
Consolidated Edison Co of N Y, Inc

(Continued on page 210)



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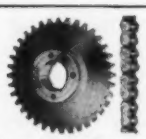
Savings up to 33% . . . efficiency up to 97% . . . are yours with this new and better kind of speed reducer. Proved in tens of thousands of installations, in all types of industry!

This reducer is mounted directly on the driven shaft. No foundation, no flexible couplings, no sliding base required. No lining up difficulties. The torque-arm, fastened to any fixed object, anchors the reducer. Unit is driven through any V-belt drive. Stock Taper-Lock Sheaves prescribed for each job. Tri-Matic Overload Release and Backstop are available if desired.

Torque-Arm Speed Reducers are sold from Distributor's stocks—in single reduction and double reduction series—with capacities from 1 to 43 hp and output speeds from 12 to 330 rpm. Standardize on this modern idea in speed reduction—it saves you money.

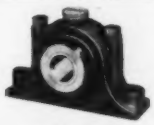
DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

DODGE
of Mishawaka, Ind.



TAPER-LOCK SPROCKETS AND DODGE ROLLER CHAIN

TAPER-LOCK SHEAVES



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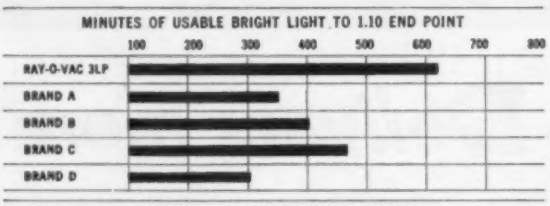
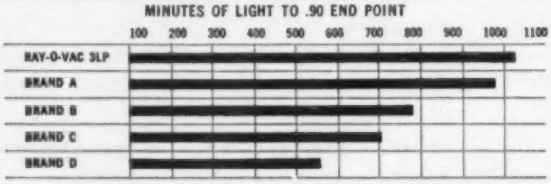
Here are amazing comparative* performance figures!





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RAY-O-VAC COMPANY

Madison 10, Wisconsin

Ray-O-Vac Canada, Ltd., Milverton, Manitoba

*Figures obtained from tests conducted under specifications established in Circular of National Bureau of Standards No. C-466.

DESIGN ADVANCES

Continued from page 208

Trinidad—Trinidad, Texas
Texas Power and Light Co

Nueces Bay—Corpus Christi, Texas
Central Power and Light Co

Knox Lee—Cherokee Lake, Texas
Southwestern Gas & Electric Co

Perlmian Basin—Monahans, Texas
Texas Electric Service Co

Greens Bayou—Houston, Texas
Houston Lighting and Power Co

West Junction—Houston, Texas
Houston Lighting and Power Co

Ninemile Point—Westwego, La
Louisiana Power and Light Co

Louisiana Sta No. 2—Baton Rouge, La.
Gulf States Utilities Co

Morgan Creek—Colorado City, Texas
Texas Electric Service Co

Waleetka—Waleetka, Okla.
Public Service Co of Oklahoma

Data for the years 1947 to 1952 were taken from the Federal Power Commission reports No. S-72, S-74, S-83, S-94, S-97 and S-104. Data for 1953 were obtained from the Federal Power Commission files.

NATURAL GAS

Continued from page 102

stant rate of opening is obtained with increase in overpressure.

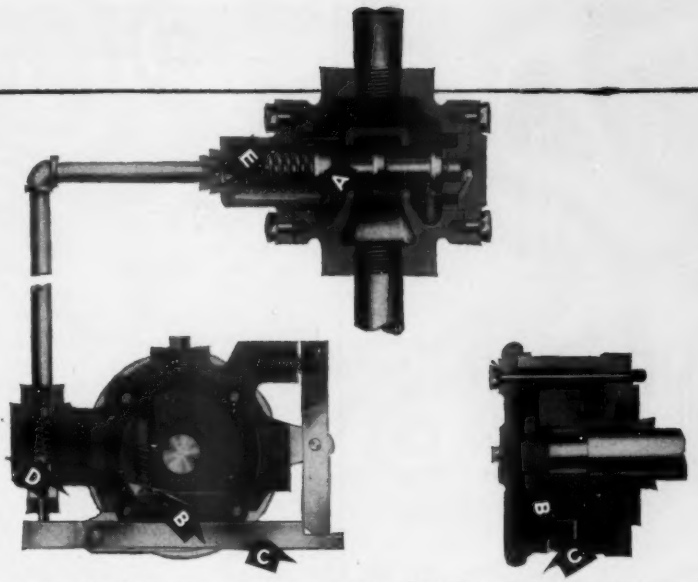
Fig. 8 shows a pilot-operated relief valve. Normal line pressure over piston holds vale closed. Overpressure causes relief pilot valve to open and bleed off pressure over piston, allowing relief valve to open. Equalizing port from gas line to above piston is closed off when relief valve opens. Blowdown pilot valve is set to open when desired blowdown is obtained. When blowdown pilot opens, gas-line pressure is again supplied above piston, causing relief valve to close. This setup makes blowdown independent of relieving pressure.

Heating-value measurement. A recording calorimeter keeps a continuous check on the heating value of the gas. Gas and air, supplied at a constant rate, are burned under set conditions. Amount of temperature rise imparted to a predetermined quantity of air measures the gas Btu content.

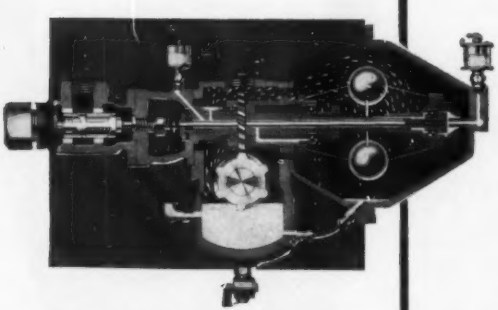
Heating-value information is a check against contract guarantees. It also gives accurate data for plant-efficiency calculations. Usually Btu content readings that will satisfy needs for steam plant checks may be obtained from distributing company.

Telemetering equipment. Under certain circumstances, readings at a metering station must be known at some distant point—either the steam plant or

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When turbine is operating, Lever C is horizontal, Pilot Valve D closed, and Valve A held open by Spring E. When excess speed is reached, centrifugal force throws Weight B against Lever C, opening Pilot Valve D. This relieves the pressure back of Valve A, unbalancing and closing it immediately, compressing Spring E and shutting off the steam supply to the turbine. When Lever C is manually reset, Pilot Valve D closes, allowing pressure to build up back of Valve A and thus restoring the balance. Spring E then opens Valve A, admitting steam to turbine.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

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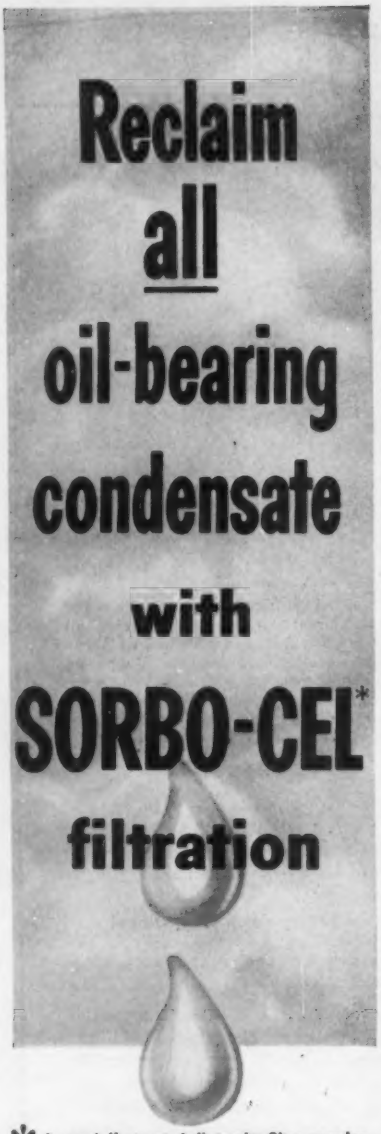

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SORBO-CEL®

NATURAL GAS

Continued from page 210

the system dispatcher's office, or both. Telemetering equipment accomplishes this. Readings may be transmitted by telephone line, carrier circuit on the power line or microwave.

With a telemetering setup, a dispatcher knows what is going on in the entire distribution system. Equipment may be set up so the dispatcher can open and close valves, change pressures or flows, or make any changes necessary to operate the gas system.

Piping. Steel has become virtually standard for metering stations. Connections are welded as much as possible. Flanges are used only at points that make it possible to remove equipment, such as control valves and meter runs.

Large savings in material and cost can be realized if piping and valves after the reducing valve are designed for the reduced gas pressure. This includes the service line from metering station to plant. All piping and valves designed for the lower gas pressure must be protected by adequate relief valves. How to get this protection is discussed below.

Piping and valving arrangement for the metering station is discussed in terms of the system in Fig. 9. This setup shows only one of many ways to design the station, but it is neat and compact, has many advantages other designs do not have. Such an arrangement is desirable for steam-plant service.

In this system, radical changes in direction are kept to a minimum to reduce noise. Elevation of control valves and meter runs is obtained by 45-deg bends. A header with a dead end has been eliminated.

As shown in the drawing, the inner meter run is used as the primary. When this run reaches a predetermined capacity, the differential trip valve opens, putting both runs into service.

Inlet line is small, and valves ahead of control valves are same size as these valves. This can be done because pressure drop is not a consideration at this point. Lines following the control valves are increased so that line to meter runs is the same size as the largest meter run. There is an additional increase in line size after the meter runs. Straightening vanes are used to give correct flow characteristics to orifice plate. Length of meter run may be shortened by use of straightening vanes, with subsequent decrease in station size.

The bypass line shown is used when the metering station is shut down for repairs or annual inspection. As pictured, one of the gate valves would be used to give manual pressure control to the steam plant. With this setup,

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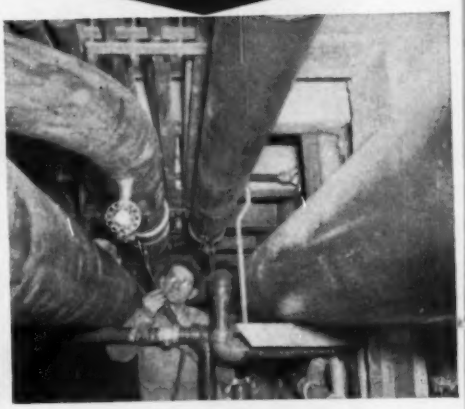
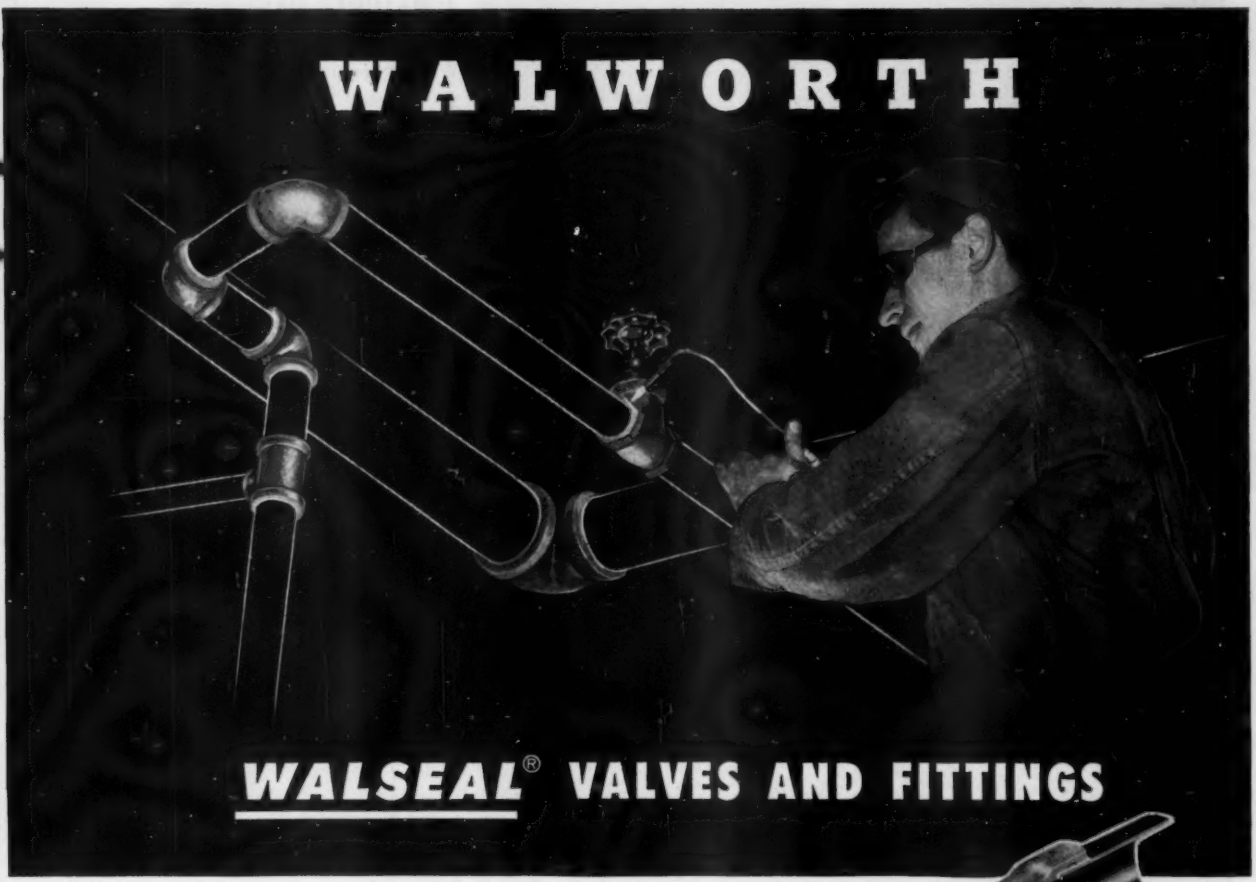
Two advantages of Walseal Valves and Fittings make them ideal for work of the type shown here, coupling a 6" brass condensate return line in a western power plant:* 1) Walseal joints are permanently leakproof, vibration-proof, and corrosion-resistant. 2) factory-inserted rings of silver brazing alloy eliminate guesswork as to the right kind and amount of alloy to use, and permit installation of fittings in cramped quarters.

For more information on complete lines of Walseal Valves and Fittings, see your nearby Walworth Distributor or write: Walworth Company, General Offices, 60 East 42nd Street, New York 17, N.Y.

*Name on request



WALWORTH



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Better because . . . **There's no guesswork when a silver-brazed joint is made with a Walseal fitting. Sil-Fos alloy, which appears as a fillet at the face of a Walseal joint, comes from rings which have been factory-inserted in the end connections of Walseal fittings. The bright silver alloy fillet that you can see assures full penetration of alloy for a permanently leakproof joint.**

Cutaway view of a Walseal Tee showing: factory-inserted ring of silver brazing alloy; fillet of silver brazing alloy that appears upon completion of Walseal joint; cutaway view of the completed joint showing that silver brazing alloy has flowed in both directions from the factory-inserted ring.

Walseal is a registered trade mark which identifies valves and fittings manufactured by the Walworth Company. Walseal products have factory-inserted rings of silver brazing alloy in threadless ports. Walseal joints can be made only with Walseal valves and fittings.

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When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

NATURAL GAS

Continued from page 212

flow measurement is not possible. It should be possible, however, to estimate the flow during the normally short shutdown period. For flow measurement while on bypass, you need an additional valve (not shown) for manual pressure control. Then orifice plate as the spectacle disk of the double gate valve could measure flow.

Going back to the problem of protecting low-pressure piping, Fig. 9 shows a possible solution. When station is in normal operation, check valve shown in relief-valve piping allows free passage of gas. When operating on bypass, check valve keeps gas from rest of station. As a great deal depends on the check valve, care should be taken in its selection. With this arrangement, low-pressure lines and valves in metering station and in service line are protected at all times.

Instrument piping may be steel, copper or aluminum tubing. Trend is toward soft annealed steel tubing. One easy way of supporting this tubing is to use prefabricated open mesh troughs available in widths of 3 to 24 in. This makes it unnecessary for welder to be occupied with field construction of troughs.

Additives. Methanol is sometimes injected into the gas line ahead of the pressure-control valves, Fig 9, to prevent formation of gas hydrates in the lines. Hydrates are icelike deposits that can plug regulators, orifice-meter tubes, etc. Pressure, temperature and moisture conditions must be right before these deposits form.

Although odorization is not a necessity in a steam plant, the added safety may well justify the small cost of equipment. The consumer normally does the job. Somewhat cheaper equipment is possible when odorant is injected into low-pressure gas.

This summary highpoints considerations involved in metering station design. Although the design may be the job of a specialist, plant personnel should become familiar with equipment and its function.

PULSATING COMBUSTION

Continued from page 92

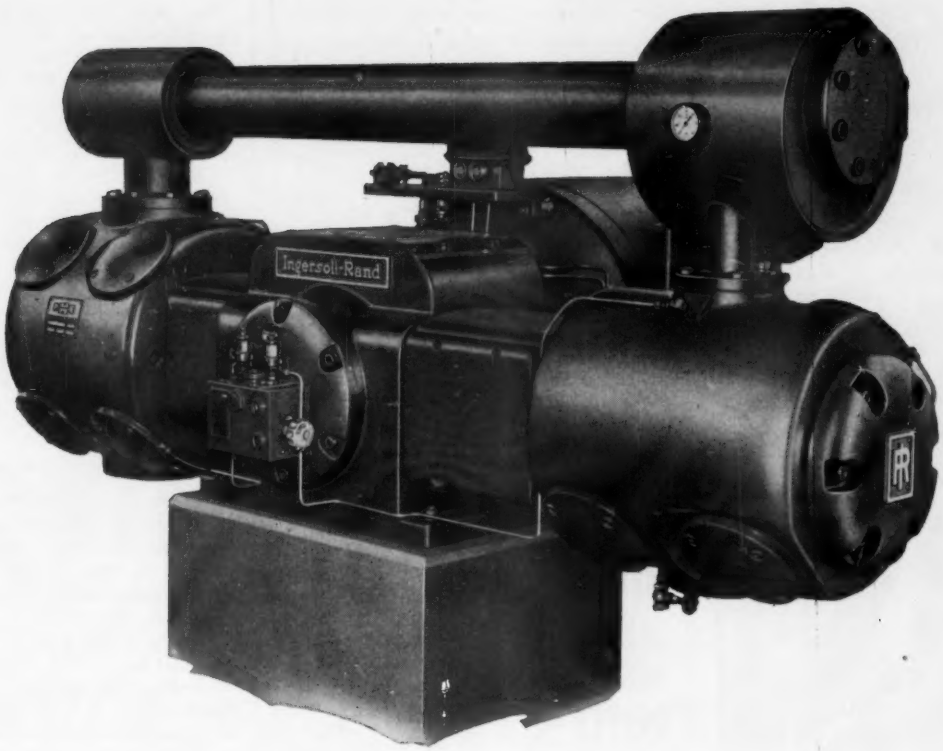
on p 92. Note that it's possible to increase heat release hundreds of times, but that heat transfer increases only slightly. These figures, however, tell us nothing about the area-to-volume ratio of the combustion space. Ordinary furnaces have relatively low area-to-volume ratios. Pulse-jets can be built small, with large cooling area—relative to volume. Intensive cooling of combustion gas by boiler water is, there-

NEW

OPPOSED-CYLINDER

BALANCED DESIGN, TYPE PHE

COMPRESSOR



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The basic design is a two-stage unit for 80-125 psi. For other pressures, or for pumping vacuums, alternate cylinder arrangements can be supplied. It will pay you to get all the facts on this new, cost-saving design. Ask for Bulletin No. 3155.

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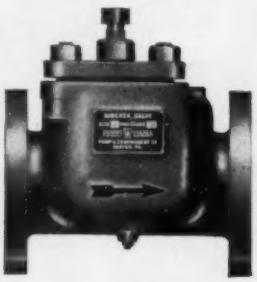

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EASTON, PENNSYLVANIA

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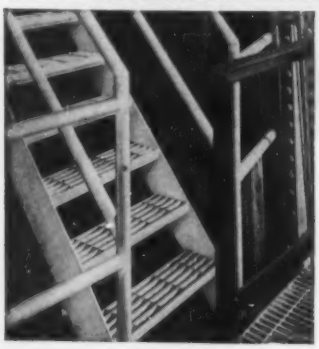

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PULSATING COMBUSTION

Continued from page 214

fore, practical. We thus compensate for moderate specific-heat transfer.

The so-called honeycomb heater is one design that could be used for high area-to-volume ratio. It's possible to build the boiler small enough to fit in the turbine room or, following up today's trend, build units of much larger capacity that need no more space than smaller-capacity conventional boilers.

Conclusions. In this series of articles we've (1) reviewed fundamentals of wave theory and vibrations (2) studied pros and cons of several different cycle arrangements as they affect thermal efficiency and construction details (3) seen how large-capacity boilers might actually be physically smaller through application of the higher heat release and heat transfer that's inherent in pulsating combustion. Although the basic idea has been with us for many years, we've pinpointed several problems here that require further study. These, no doubt, will challenge the imagination of our best engineers. But the gains from the success of such a venture amply justify the effort.

ARGUMENTS

Continued from page 142

in school assemblies; trying out fields of engineering by means of projects; performing simple engineering-type services for their schools; seeing movies about engineering; making personal contacts with engineers.

Teachers are highly interested because it gives their students a chance to learn, while still in high school, the *applications* of mathematics, science, drafting and shop courses they are taking. And they are often surprised by the enthusiasm students show.

We understand that General Electric Co has organized several high-school clubs in the Schenectady-Troy area, using the material our *Jets* clubs have been using. We'll be glad to cooperate with any organization interested in starting a similar club. Some day we'd like to see *Jets* become a national organization, sponsored by engineering groups, land-grant colleges or industry.

H P SKAMSER, *Director,*
JETS program, Michigan State College, E. Lansing, Mich.

Typographical error. July issue was even better than usual, but one typographical error crept in. Data sheet listed specific volume in lb per cu ft instead of cu ft per lb, as it should be. And in such big letters!

H HOLCOMBE *Los Alamos, N. M.*

EDITOR'S NOTE: *Holcombe is right.*

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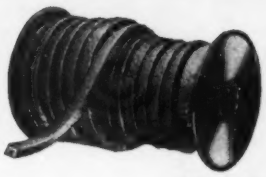

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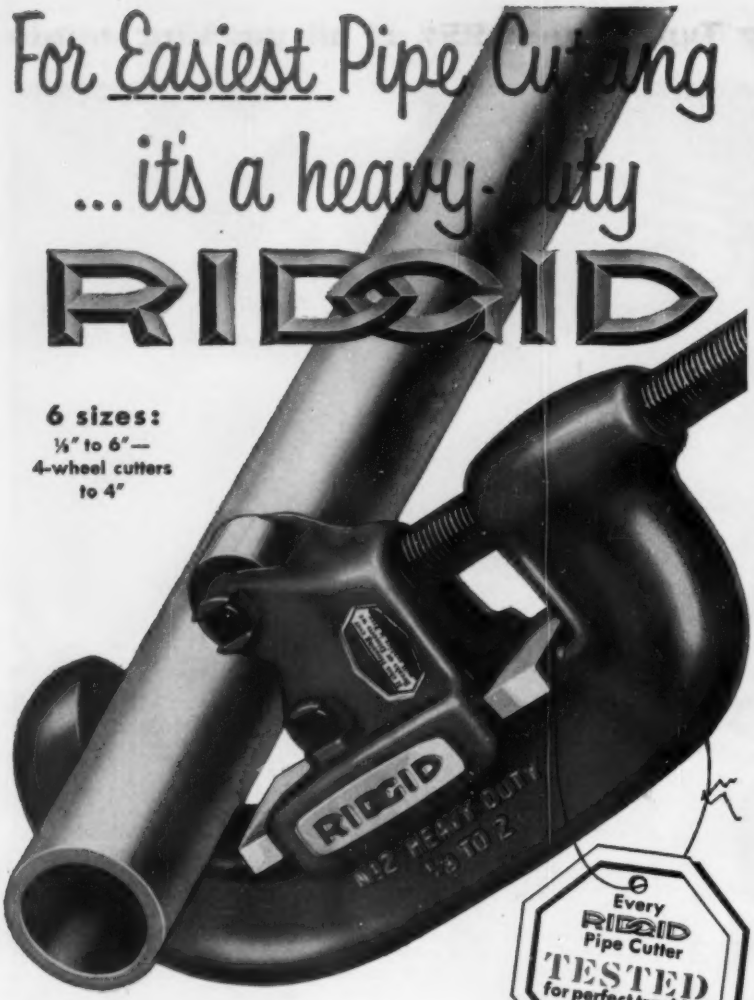

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RESIDUAL FUEL OIL

Continued from page 101

typically met with a fuel whose ash is high in vanadium, low in sodium (photo on p 101).

The other type is more amorphous, ranging from a granular structure to a powder (photo). Color is lighter and may range from greenish-white to greenish-brown and brownish-black. Structure is less dense and deposits more voluminous. This type forms from fuel ashes high in sodium, but low or only moderately high in vanadium content. It is often possible to distinguish several layers, each quite different in coloration and in chemical analysis.

The hard, black, crystalline type of slag analyzes quite high in vanadium, but has an appreciable amount of sodium, most of it probably in sulfate form. The amorphous type, on the other hand, has about twice as much sodium, probably as a sulfate, and a relatively small amount of vanadium. Undetermined portions of both slags contain other metals (iron, silica, magnesium, calcium, etc) in minor amounts. Amorphous-type slag is generally better than 90% soluble in water while the hard black slag is considerably less soluble.

There appears to be no truly satisfactory explanation of the mechanism of slag deposition. Our own analyses indicate in a general way that where vanadium and sodium are both present in fairly large quantities, the vanadium content tends to increase toward the back end of the furnace. Deposits on superheater tubes tend to show higher vanadium content as the various layers build up. Regardless of the actual mechanism of slag build-up, we believe it has been pretty well established by field experience that sodium compounds in the ash contribute more to slagging problems than vanadium.

What remedies have been tried for the slagging problem? Water washing has been successful in removing slag accumulations. If done periodically, before slag builds up to a critical point, boilers can be kept reasonably clean.

Another method involves use of dolomite as a fuel additive. Calcium and magnesium compounds modify characteristics of fuel-oil ash, making deposits more friable and easier to remove. They appear to act by raising over-all fusion point of slag so it adheres less firmly to metal surfaces. This can be economical if adequate facilities are provided to blow off deposits periodically. In future designs, blowing and lancing facilities should have serious consideration if they are to cope with additive-containing fuels.

High-temperature corrosion has been met in high-temperature boilers, particularly at superheater hangers and

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WRITE FOR BULLETIN 350

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Mfrs. of Industrial Laboratory Recording and Dial Thermometers

RESIDUAL FUEL OIL

Continued from page 218

sometimes on superheater tubes themselves. It also presents a problem for the gas turbine burning residual fuel.

Heavy research has been, and is, aimed at studying these effects of fuel-oil-ash constituents, particularly vanadium and sodium. While it is not easy to separate entirely the effects of ash constituents on high-temperature corrosion, there is no doubt that vanadium is a major factor. We have studied this on a laboratory scale by exposing specimens of 25-20 chromium-nickel steel to flue gas from burning commercial residual fuels containing various concentrations of vanadium.

At a specimen temperature of 1600 F, measurable corrosion occurs quickly, even at low vanadium concentrations. At higher vanadium levels, such as might be found in a substantial portion of the fuel used along the Atlantic coast, corrosive effect at 1600 F can be very severe in a short period.

Temperature exerts marked influence on rate of attack. With a high vanadium fuel, attack is relatively slow below 1200 F. Above this point, corrosivity accelerates and about ten times as much corrosion was observed at 1600-F metal temperature as at 1300.

There is considerable evidence that sodium compounds in the oil ash, mostly in the form of sulfates, can be as destructive under certain conditions as vanadium, although the type of attack seems to differ. Our limited combustion studies to date show little evidence of this attack until temperatures above 1600 F have been reached. The important point is, however, that vanadium is not the only troublesome ash constituent. Sodium compounds, notably the sulfates, may be important contributors, particularly as metal temperatures increase.

This high-temperature corrosion problem is being attacked from many angles, including development of more-resistant alloys and coatings, cooling of metal parts, use of additives in the fuel, and the actual removal of ash from the fuel. Use of additives appears one of the most promising approaches. Results from a number of research programs should soon yield concrete answers.

What's ahead? Indications are that decline in residual-fuel yields will continue and that an increasing portion of future available residual, on the East coast at least, is apt to come from Venezuelan-type crudes. These and other factors promise to keep the spotlight on the effects of fuel-oil-ash constitutents and to lend continued importance to cooperative efforts to minimize them by designers, operators, and fuel-oil suppliers.

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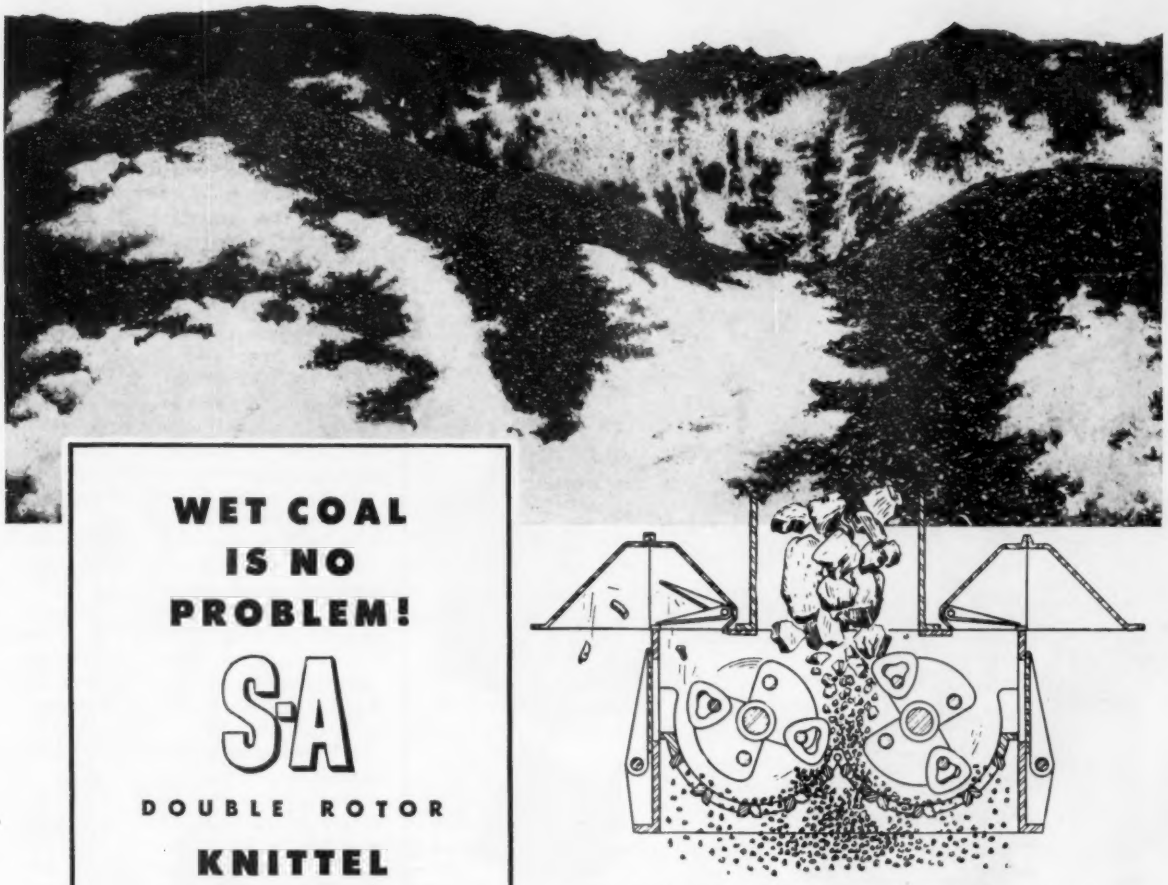

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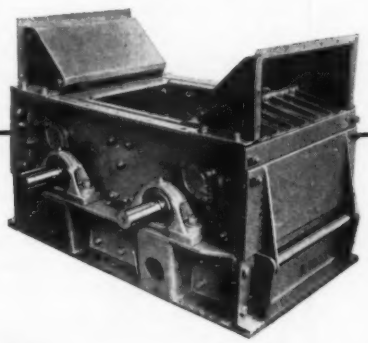

Snow or rain-soaked coal doesn't reduce the crushing capacity of an S-A *Double Rotor* Knittel Crusher. *Two* high speed rotors, rotating towards each other on separate drives, split oversize lumps—reduce run-of-mine coal to size in a single operation.

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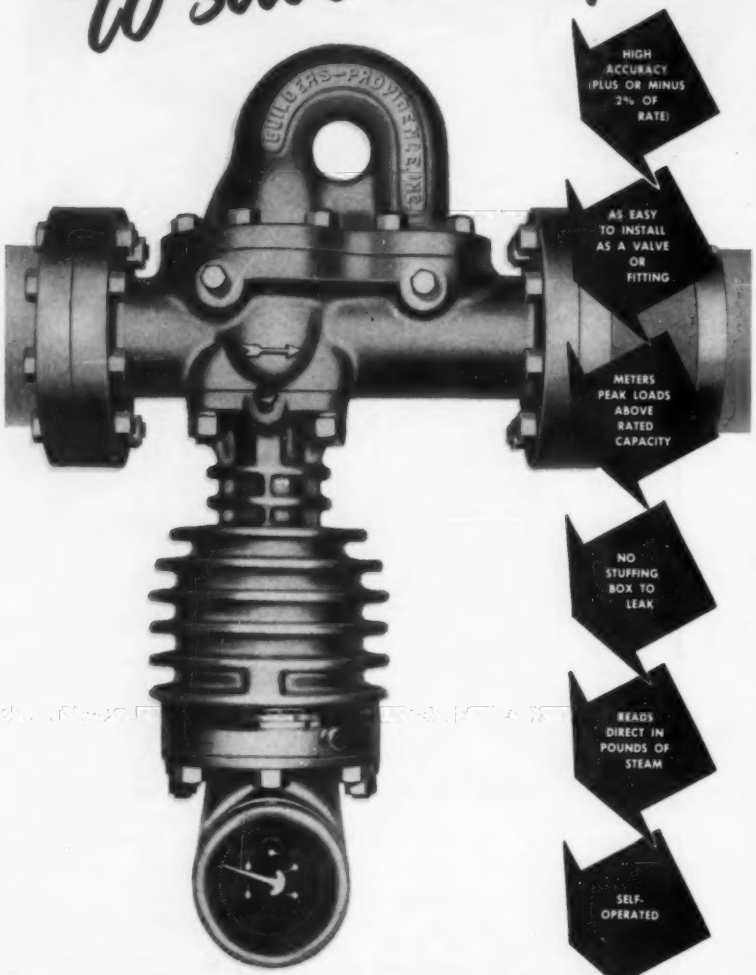
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More TECHNICAL BRIEFS

Begins on page 156

tion it has been found that anion exchanger loss is much less than was predicted and there is a possibility of further reducing it by using a different resin. Demineralizer provides water at loads where the evaporator would not be available. *APC paper; no number.*

The expected life of anion exchangers under various conditions of deionizer design and operation. *By Louis Wirth, Jr, National Aluminate Corp.*

Available information on stability characteristics of highly basic anion exchangers is limited to laboratory studies and scattered reports of operating experiences. Efforts to arrive at suitable amortization rates for these products have of necessity involved considerable extrapolation and at times some pure guesswork.

Factors having significant influence on resin life include selection of proper type of anion exchange resin for the water-supply conditions, complete removal of gas from water passing through large deionizers, organic matter in water supply and conservative design for adequate operating exchange capacity.

Economically useful life of contemporary strong-base anion exchangers may only be five to six years. In certain instances shorter periods of life may be expected, and in others longer life will be realized. *APC paper; no number.*

Some chemical aspects of hot process-hot zeolite plant performance. *By M Lane and J H Duff, Graver Water Conditioning Co.*

Introduction of sulfonated styrene cation exchange resins about 1944 provided for the first time a practical means of softening waters at elevated temperatures. Early attempts to soften high-temperature water with synthetic siliceous and phenolic-type exchangers failed because of inability of these zeolites to withstand this service.

Even after sulfonated styrene resin became available, a few years elapsed before it was applied to the softening of hot-process effluents. About 1949 comparatively small-scale plants were put into operation. Acceptance of the process was immediate and many plants were installed from 1950 on, the majority of which have been operating for two to three years.

There has been little resistance to using this process, despite its newness. This is basically due to its substantial advantages over the two-stage hot-phosphate method. Actually, it is not completely new as, for example, demineral-

Directions for ordering papers on p 226

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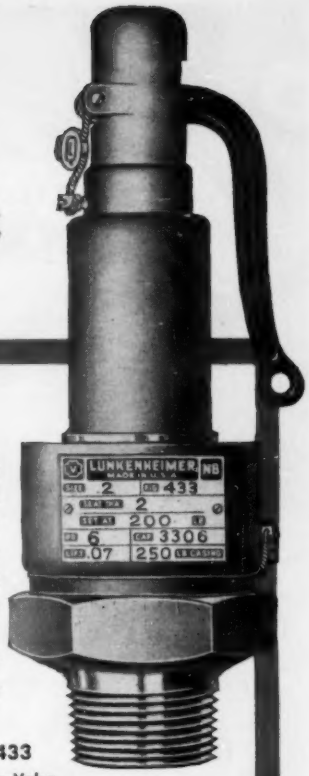

Fig. 433
Pop Safety Valve

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Pop Safety Valves are used in conjunction with gases, including steam. They pop wide open when the set pressure is reached, stay open until pressure has dropped . . . then snap shut instantly. **Relief Valves** are used in conjunction with liquids. They start to open at the set pressure but require about 20% overpressure to open wide. As pressure drops, they start to close and shut tight when the set pressure has been reached.

Fig. 658
Relief Valve

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More TECHNICAL BRIEFS

Begins on page 156

izing, because it combines two well-known older processes. But combining the two processes introduced certain new factors which must be considered in design and operation.

Basic chemical and mechanical design factors are now well understood and the problems encountered are, in the authors' experience, minor ones. However, in working with this process during the past few years in many plants, large and small, certain problems have arisen requiring new solutions and the authors observed the need for more information on some chemical phases of the process.

For plant designers and operators the paper considers a number of factors, including effect of applied turbidity on performance, zeolite effluent total hardness, resin particle size and silica reduction calculations. *APC paper; no number.*

Hydro development

Development of Niagara Falls for hydroelectric power by United States and Canada. *By Francis L Adams, Federal Power Commission.*

Favored by a total concentrated fall exceeding 325 ft and the unparalleled regulation of four Great Lakes, Niagara Falls section of the International Niagra River provides one of the world's best power sites. Development of this great natural resource was first undertaken toward the end of the 19th century when water was diverted around Niagara Falls for production of mechanical power.

Since that time development has continued, first in the form of mechanical power and later as hydroelectric energy. At present, in conformance with a recent treaty liberalizing use of waters in the Niagara River, Canada is proceeding with construction of hydroelectric facilities that will increase capacity by 1,375,000 kw. Tentative plans for increasing the U.S. side by about 1,330,000 kw have been considered. *WPC paper; no number.*

The recent study on the joint utilization of hydro and thermal electric power in Japan. *By Junji Noda.*

Though seasonal stream-flow variations of rivers in Japan are great, it is a basic principle to work out increment of supply capability against increment of power demand, by the combination of hydro power and supplemental thermal power.

In these cases the problem lies in determining the best combination of

Directions for ordering papers on page 226

Fly Ash Problem Solved By Central Station

This Pennsylvania utility felt that as long as you can *see* dirty stack discharge, you have a problem. To solve it, they decided to insist on fly ash collection equipment with very high efficiency.

The electrical precipitators they chose, which were placed after existing mechanical collectors, are Cottrells, designed and built by Research Corporation. Their effectiveness is demonstrated in the above unretouched photographs. At the left, the precipitators were turned off long enough to take the picture showing the volume of fly ash discharged by the boilers. At the right, the precipitators are turned back on. Stack discharge is visually clean.

This is another example of industry's trend toward establishing its own higher standards for nuisance abatement. Research Corporation, which has made more fly ash installations than any other company, cites the following comparison:

In the period from 1923 to 1939 only 11% of its power plant customers specified fly ash collection efficiency of 95 to 98%. In recent years, that 11% has risen to fully 90%.

One reason, of course, is the generally increasing emphasis on community relations. Another factor is that farsighted companies are anticipating stricter smoke regulations. They are anxious to install equipment that will end their smoke problems now and also prevent such problems from occurring in the future.

Still another factor is this. In recent years, with modern coal pulverization and advanced boiler design, there has been an increase in the fineness of fly ash particles. This calls for the most efficient equipment available.

Read—in Bulletins FA and MI—about Cottrell equipment and the Research Corporation's MI Rapper. This device eliminates rapping puffs and enables the precipitator to maintain, continuously, its high collection efficiency. Write for your copies today.

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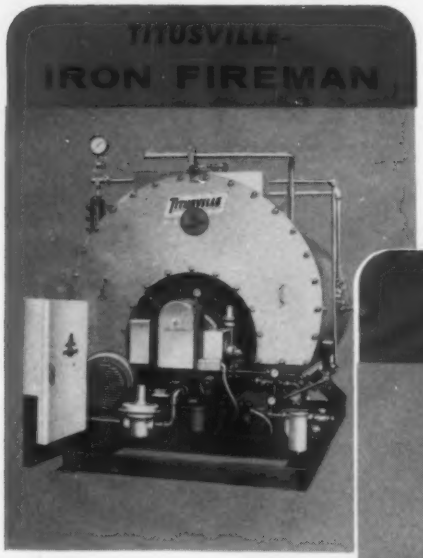

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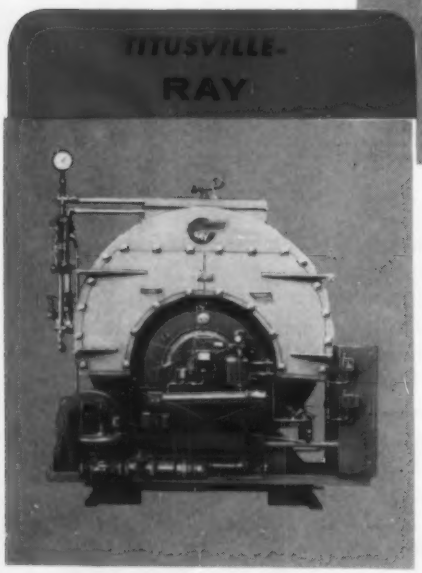

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Begins on page 156

hydro and thermal yielding minimum first cost for a predetermined load. This study assumes a straight-line relation for the load duration curve and natural stream flow. Using a constant, k (= hydro generating capacity with natural flow during poorest water season/maximum power demand of load), the study shows first cost is minimum when k = 0.3. *WPC paper; no number.*

Hydroelectric power stations in Faroe Islands (Denmark). *By Stenild Hjorth.*

In a remote situation in the North Atlantic, some 185 miles northwest of the Shetlands and about 280 miles southeast of Iceland, 18 inhabited islands and numerous islets of the Faroes rise steeply out of the sea. The islands lie, arching their back to the west where erosion of the sea has created vertical walls of rock to 2450 ft high.

At Vestmanna a new 3000-hp Pelton turbine designed for a head of 720 ft will help improve power supply to three of the islands. Space is provided for a future 5000-hp turbine. After its installation total annual output of the plant will be 15-million kwhr.

Line system and transformer equipment for about 3000 households, industries, etc, comprises about 85 miles of high-tension overhead line and 40 transformer substations. The company is an inter-municipal cooperative society. *WPC paper; no number.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39 St, New York 18, New York.

American Power Conference, 16th annual meeting. Identified by initials APC and obtainable through purchase from R A Budenholzer, chairman, Illinois Institute of Technology.

World Power Conference, 4th meeting. Identified by initials WPC and obtainable from Secretary, Brazilian National Committee, WPC, Rua Visconde de Inhauma, 134-15 Pav, Rio de Janeiro, Brazil.

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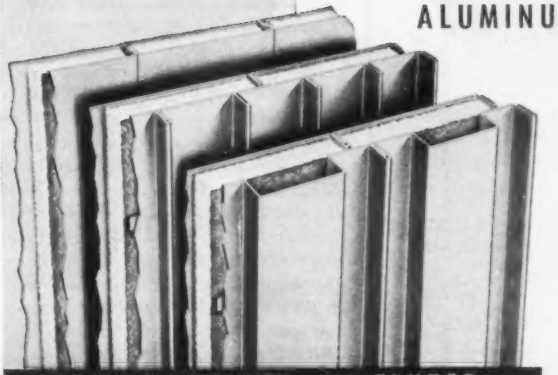

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Over-all "U" Factor of Various Types is Equivalent to or Better than Conventional 16" Masonry Wall

Mahon Insulated Metal Curtain Walls have been selected for thirty-four modern powerhouses in recent years—four more are currently under construction . . . about half of these, including one for T.V.A., were built for public service organizations —the remainder were power and steam generating plants for private industrial and commercial concerns. There is a definite trend toward this type of light-weight curtain wall construction in modern powerhouse design. And there's a reason for Mahon preference in this particular field . . . the Mahon "Field Constructed" Fluted or Ribbed Wall can be erected up to sixty feet in height without a horizontal joint —a feature of Mahon walls which is extremely important in powerhouses or other types of buildings where high expanses of unbroken wall surface are common. In this type of construction, important building economies are realized through lower material cost, lower labor cost, and the cumulative advantages deriving from reduced construction time . . . buildings can be quickly enclosed with Insulated Metal Walls—even under low temperature conditions which would preclude masonry construction. Mahon Insulated Metal Walls are available in the three exterior patterns shown at left. See Sweet's Files for complete information, or write for Catalog B-55-B.

Powerhouse at the Lincoln-Mercury Plant, Wayne, Michigan. In this powerhouse, and the adjoining plant, 175,600 Sq. Ft. of Mahon Aluminum Insulated Metal Walls were employed. Five other complete plants have been built by the Ford Motor Company with Mahon Aluminum Curtain Walls.

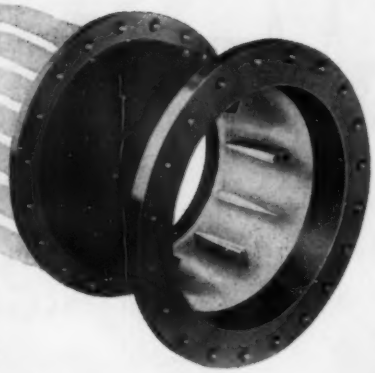
THE R. C. MAHON COMPANY

Detroit 34, Mich. • Chicago 4, Ill. • Representatives in All Principal Cities

Manufacturers of Insulated Metal Walls and Wall Panels; Steel Deck for Roofs, Partitions and Permanent Concrete Floor Forms; Rolling Steel Doors, Grilles and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Fire Shutters.

MAHON

FOR *LOWEST* HEAD LOSS IN FLUID METERING



The *Gentile** FLOW TUBE

*GEN-TIL-LY

WHERE HEAD LOSS IS IMPORTANT...The Gentile Flow Tube can be designed to produce a measurable differential with lowest permanent pressure loss of *any* head meter.

ACCURACY... Differential is produced from points of equal cross-sectional area. Furnished with head capacity curves, and guaranteed for exceptional accuracy when used with any standard indicating, recording or integrating meter.

REVERSIBILITY...When the flow is reversed, the differential is reversed. Permits metering reverse flow at lowest possible equipment cost.

LOW INSTALLED COST... Average length is only 1½ times the pipe diameter, and straight runs entering and following are not required unless installed near throttling valves or regulators.

Write for Bulletin FT-101 or specific recommendations.

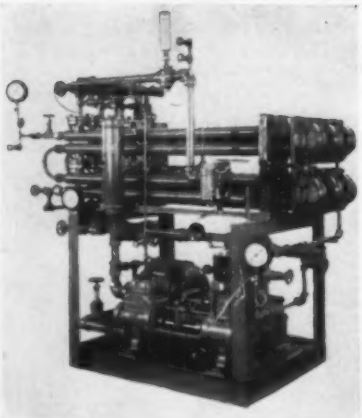
FOSTER ENGINEERING COMPANY

835 LEHIGH AVENUE UNION, N. J.

AUTOMATIC VALVES • SAFETY VALVES • FLOW TUBES

LOCKETT FUEL OIL PUMPING AND HEATING SETS

Custom Built



A composite Pump and Heater Set, consisting of one Steam-Driven Duplex Pump and one Electric-Driven Rotary Pump, with Heater Units mounted above the Pumps. Complete with Pressure and Temperature Controls. Capacity 4,000 pounds per hour of bunker C fuel oil against 300 P.S.I.

For more than a half-century, Lockett has been supplying standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Various types of Pumps are available: Turbine or Motor-Driven Rotary Pumps, Electric-Driven Rotary Pumps, and Duplex Steam Pumps, in any combination. Units can be furnished for any capacity or pressure desired; complete with Strainers, Pressure and Temperature Controls, and Instruments. Each pump is suitable for the full rated capacity of the Unit; one pump and one heater are spares. Engineered to your requirements. Completely assembled and shop-tested. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.

Contracting Mechanical Engineers

NEW ORLEANS • HOUSTON • DALLAS

More POWER NEWS

Begins on page 154

When completed, the transformers will be operated for field test experience by Consolidated Edison Co.

Safer operating characteristics without complications of present liquid dielectrics is a main advantage of the unit. They are expected to have improved sound characteristics since pressurized gas is a much poorer transmitter of sound than liquid. Furthermore, Ginn explained, omission of oil and reduced core and coil dimensions, possible in the new transformers, should produce lighter units.

Dry-type transformer construction has been limited, to date, to about 15 kv. While many existing units have sealed nitrogen-filled tanks, main purpose of the nitrogen is to exclude oxygen and water vapor rather than to obtain any improvement in dielectric and cooling properties. Sulfur hexafluoride under moderate pressure offers promise of both a dielectric and coolant. New units will utilize a gas-to-air heat exhanger.

Oakite Products opens new lab for cleaning, corrosion research

► OAKITE PRODUCTS INC, manufacturers of industrial cleaning solvents and machinery, announced the opening of their new research laboratory in New York City.

Facilities include bacteriological, analytical, organic and inorganic labs. Another section is devoted to customer problems. Here with special equipment, chemists and technicians solve cleaning problems submitted from the field.

One of the materials developed by Oakite chemists is a high-flash-point solvent that doesn't conduct electricity, won't burn at ordinary temperatures.

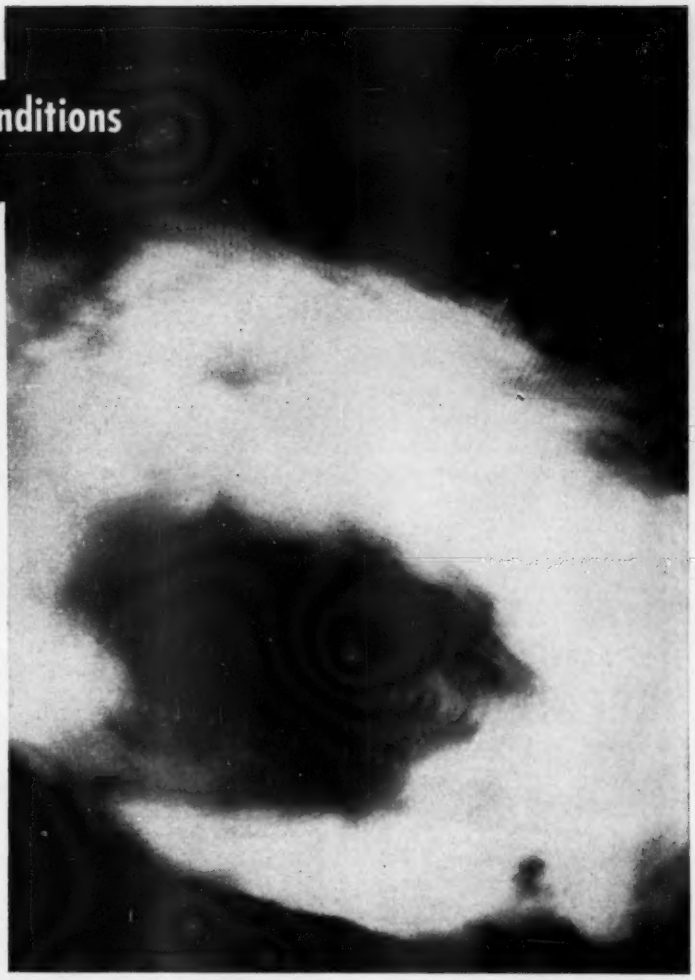
Midwest's largest power plant has capacity of 800,000 hp

► ADDITION OF A fourth 150,000 kw turbine to Commonwealth Edison Co's Ridgeland Station, Cook County, Ill, completes the largest power plant in the Middle West, and one of the most efficient in the country.

Nameplate capacity of the station is now 600,000 kw. The station consumes

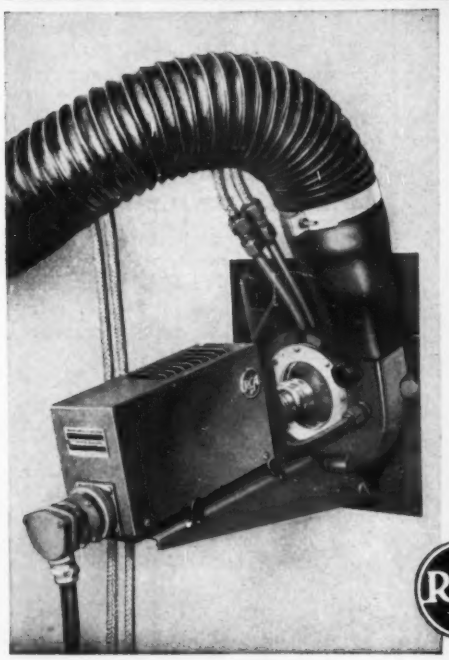
Now watch combustion conditions every minute of the day

. . . with RCA Industrial TV



With RCA's new water-cooled window—you maintain continuous observation of flame conditions and ignition—*at the control panel*—24 hours a day. High-detail picture eliminates the need for periodic observation of furnace and checking burner operation.

Water-cooled window can be installed at top of furnace to observe tangential firing—in side of furnace to observe direct firing. High-capacity blower and pump unit can serve two windows.



HERE'S THE ANSWER to continuous, low-maintenance, fail-safe observation of furnace conditions . . . high-detail RCA Industrial TV (ITV-5A) and the new RCA water-cooled window.

By using a high-efficiency circulating system, RCA has reduced lens temperatures at the camera below 120° F—for stable, dependable camera operation.

The RCA Industrial TV water-cooled window is a reliable tool for use by your operators for continuous remote observation of combustion conditions. RCA now offers this new revolutionary equipment as a complete, engineered package to power plants—plus installation and maintenance service.

FOR INFORMATION on RCA Industrial TV (Type ITV-5A), write Radio Corporation of America, Dept. K-208, Building 15-1, Camden, New Jersey.

INDUSTRIAL PRODUCTS

RADIO CORPORATION of AMERICA

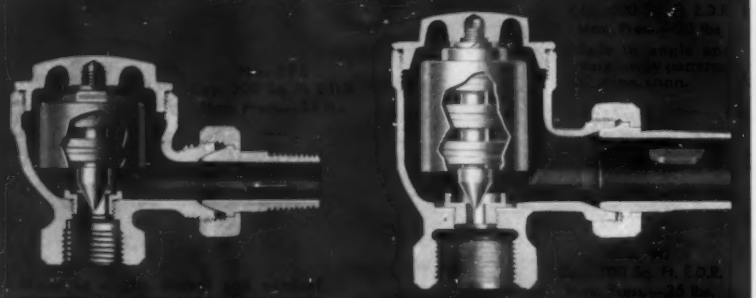
ENGINEERING PRODUCTS DIVISION ***CAMDEN, N. J.***

In Canada: RCA VICTOR Company Limited, Montreal

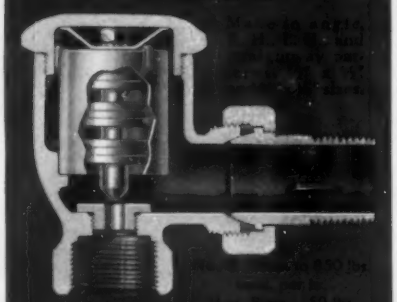
HOFFMAN STEAM TRAPS

FOR LOW, MEDIUM and HIGH PRESSURES

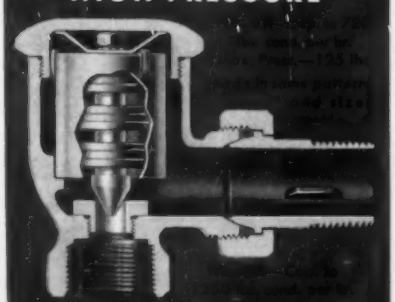
LOW PRESSURE TRAPS



MEDIUM PRESSURE

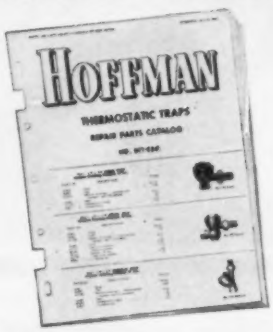


HIGH PRESSURE



FREE CATALOG

REPAIR PARTS



Here is your quick accurate guide to selection of parts needed for the profitable repair or replacement of Hoffman Thermostatic Traps. Includes listing of parts for discontinued series. Write for your free copy today.

Hoffman offers a complete line of Low, Medium and High Pressure Thermostatic Traps with uniform guarantee of quality and precision workmanship. A full range of sizes and capacities assures you the correct trap for service with radiation, dryers, sterilizers, mangles, cookers and similar uses. Body, cap, nut and tail piece are of high quality brass. Other features of design contribute to long life.

HOFFMAN SPECIALTIES FOR STEAM

More POWER NEWS

Begins on page 154

an average of 6000 tons of coal, or equivalent, per day and its output of electricity is enough to serve a city of more than a million population. Steam at a pressure of 1800 psi and temperatures to 1050 F is used. Cost of plant, with connecting transmission facilities, was in excess of $100 million.

Prize winning design of ASME symbol contest

► The American Society of Mechanical Engineers announced winners in its contest to find a suitable symbol and motto for its 75th anniversary celebration in 1955.

Symbol winner is Andrew T Lemmens, design engineer for The Gleason Works, Rochester, N. Y. David H Ray, retired mechanical engineer of North Tarrytown, N. Y., received top mention for his motto, "By Truth and by Service." Each winner will receive $250.

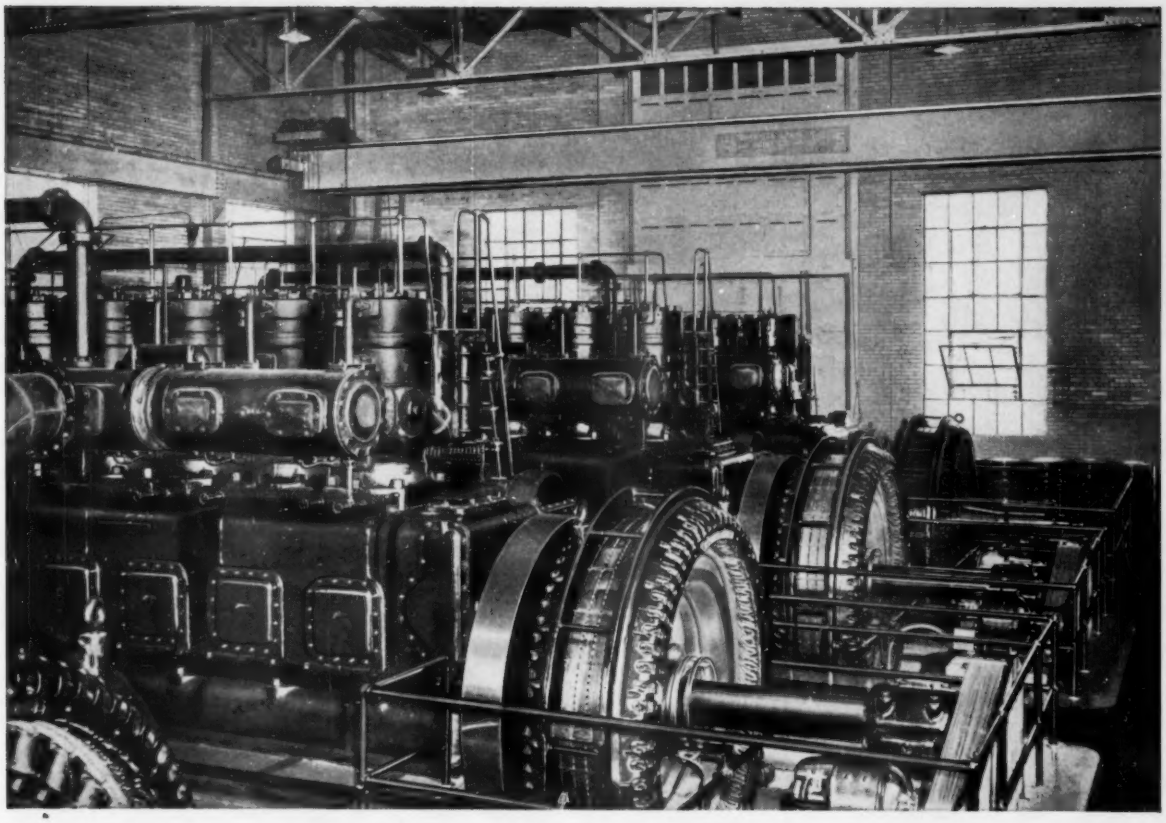
Winning design (shown above) combines a representation of the intersecting orbits of the atom, traditional symbol for nuclear power, with a representation of the thermodynamic cycle, by which heat is converted into energy and back again.

Sweden goes to Arctic Circle for large blocks of power

► Sweden is installing some of her greatest water-power plants and the world's largest hydroelectric units along the Arctic Circle. Biggest hydroelectric development, Stornorrforsen, will have total capacity of 390,000 kw, supplied by three 130,000 kw generators. It is located on the Ume River, about 200 miles south of the Arctic Circle.

Harspranget plant, on the Lule River, 22 miles north of the Arctic Circle, is equipped with three 105,000 kw units. Each generator connects to a 130,150-hp Francis turbine operating under 335 ft head at 166.7 rpm. Power from this plant is transmitted at 380,000 v, highest used in the world.

Projus plant, also on the Lule River,



"We're Proud of This Plant!"

says Don H. Decker, — Plant Supt., Thumb Electric Cooperative, Ubly, Mich.

Manager Orville Hurford and Mr. Decker are justifiably proud of their 4-diesel engine generating station. The plant has been an outstanding financial success since the day it was first opened. Several times it has occupied #1 position on the REA Running Plant capacity chart.

Mr. Decker writes, "A large part of our operating success we attribute to Sinclair GASCON® D oil. It has given us an excellent rate of consumption while reducing wear. In fact, *cylinder and piston ring wear is much below normal based on other plants of equal capacity*. Something else we appreciate is the timely visits of the Sinclair Lubrication Engineers."

Top quality lubricants plus the assistance of Sinclair Lubrication Engineers are two of the reasons why Sinclair can play a large part in the success of *your* operation. Your local Sinclair Representative will be happy to explain the remaining reasons. Phone him or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save Wear and Replacement

Check the Liquid Level From Anywhere in the Room

with the NEW CONVEX SCALE Jerguson TRUSCALE Remote Reading Gage

Compensated Manometric Gage meets new interpretation of the boiler code for WSP of 900 psi or higher.

You get full 180° visibility . . . so you can read the liquid level from any point from which you can see the gage . . . with the New Convex Scale now available on Jerguson Truscale Remote Reading Gages. Scale markings are directly on the convex face and the indicator goes clear around the convex surface. You can stand at one end of the control room and instantly check your whole line up of Truscale Gages.

Jerguson Truscales give you instant remote readings of liquid levels of boilers, deaerating tanks, etc. . . . with the amazing accuracy of ½ of 1% of scale reading. And with the New Convex Scale you make these readings from any angle . . . accurately, without distortion. Truscales also available with lights, horns and Truscale Repeaters.

Write today for complete data on Truscale Gages with the New Convex Scale.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.

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More POWER NEWS

Begins on page 154

29 miles north of the Arctic Circle, designed for 240,000 hp, utilizes ten units operating under 174-ft effective head. This plant has been in operation for 30 years.

These three plants, totalling 1,150,000 hp, are owned by the Royal Board of Water Falls of Sweden. They are of underground design, being installed in chambers excavated in solid rock.

Massive dynamometers offer test facilities to 20,000 hp

► A 10,000-hp, high-speed, eddy current absorbing dynamometer, built by Eaton Manufacturing Co, will be used with another such unit to provide test facilities to 20,000 hp. Units have speed, at this horsepower, of 600 to 5800 rpm. The combination is one of largest high-speed dynamometer installations built.

To permit runs to 15,000 rpm, a gear reducer is located between dynameters and unit under test. Gear reducer and both dynamometers are mounted in turnnion bearings so torque developed can be read on acutely accurate weighing instruments. By obtaining torque and speed valves horsepower developed may be determined.

Total torque of dynamometers at 600 rpm is 175,000 lbs ft; at 5800 rpm it is 18,000 lbs ft. Water required to cool dynamometers when absorbing 20,000 hp will be 2000 gpm, or 2,880,000 gal per day. Electronic control will supply 36 kw of dc current to accurately control torque and speed. Each unit has 14 large circular wound coils.

Hobart Bros experiment with gas turbine type arc welder

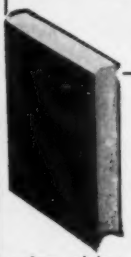
► FIRST ARC WELDER to use a gas turbine as a prime mover has been successfully operated and tested under actual working conditions.

Developed by Hobart Brothers, scientific research division, Troy, Ohio, the 250 ampere capacity unit is not a commercial venture. Purpose of the development is to learn more of the gas turbine and the possibilities it might hold for use in building more compact, lighter-weight equipment.

(More Power News on page 234)

NEW complete guide to better use of

COMPRESSED AIR POWER



Here's practical technical help on the whole range of compressed-air equipment and systems—how they're planned, selected, tested, operated, and maintained. Every important type of apparatus is covered—pneumatic tools, rock drills, and other air-powered devices, compressors, drivers, aftercoolers, piping, and even entire compressed-air distribution systems.

Whether you want answers to questions on operating a jackhammer or are faced with engineering an entire compressed-air system, this book can help you—show you how to reduce labor costs and increase profits with compressed air! It's all from the one best source for this kind of data—the experts who have spent years making and using all types of compressed - air equipment and accessories.

COVERS
—compressors
—air-powered drills
—rotating grinders
—pneumatic hammers and riveters
—air hoists
—and scores more!

Just Published—Second Edition!

COMPRESSED AIR HANDBOOK

By the Compressed Air and Gas Institute

Second Edition, 383 pages, 6 x 9, 71 tables, 335 illustrations, $8.00

This handbook, simply written yet technically thorough, gives you an enormous fund of information on pneumatic grinders, drills, and impact wrenches, air hoists, drivers, stopers, etc. An entire section devoted to the industrial applications of compressed-air power guides you in selecting the right piece of compressed-air equipment for a particular industrial job.

The entire set-up of the compressed-air system is discussed in detail. You get specific information on all types of compressors, drivers, intake air filters, aftercoolers, air receivers, and interconnecting piping—everything you need for top results from compressed-air power!

Testing

Gives you each step in testing to determine the performance of air compressors and blowers and to make sure they stand up to performance guarantees. These methods are based on the ASME Power Test Codes for Centrifugal Compressors, Displacement Compressors, Blowers and Vacuum Pumps.

This Second Edition features a new section on centrifugal compressors and additional data on new types of pneumatic tools, displacement-type compressors and compressor installation methods.

Low price

Send coupon below and see **Handbook** 10 days free. After 10 days, if satisfied, you pay just $8.00 for this 383-page compressed-air guide. If you don't want book, simply return it and the matter is closed—no obligation.

10 DAYS' FREE EXAMINATION

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Send me Compressed Air Handbook for 10 days' examination on approval. In 10 days I will remit $8.00, plus few cents delivery, or return book postpaid. (We pay delivery if you remit with this coupon; same return privilege)

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"Featherweight" 85% Magnesia was installed on the ducts, housings and lines of these "making" machines in the plant of Behr-Manning Corporation, a division of Norton Company. Insulation contractor—Armstrong Cork Company.

Heat saved... Money saved with K&M high temperature insulations

K&M insulations keep costs down by holding heat losses to an absolute minimum. You can always count on dependable "Featherweight" 85% Magnesia Insulation to provide exceptionally efficient heat conservation.

Made of 85% basic carbonate of Magnesia and asbestos fiber, "Featherweight" 85% Magnesia effectively insulates piping and equipment with temperatures up to 600°F. Used with K&M Hy-Temp insulation, its range is extended to 1900°F. This insulation combination lasts the life of the equipment it serves, withstands moisture, vibration and frequent temperature change.

New and now available is "Featherweight" Water-Resistant Magnesia insulation for temperatures up to 450°F. It is used underground where severe water exposure may damage the insulation or on indoor steam heated lines and equipment where high humidity and moisture are present.

Your K&M distributor is an experienced applicator who will gladly give you details about these money-saving insulations. Or write directly to us.

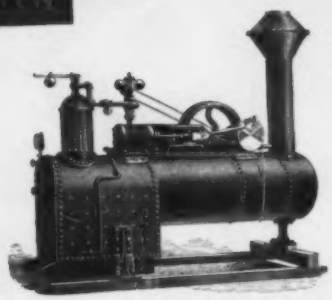
KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos... Keasbey & Mattison has made it serve mankind since 1873

IN CANADA: ATLAS ASBESTOS COMPANY, LTD., MONTREAL, TORONTO, WINNIPEG, VANCOUVER

K&M best in asbestos ®

THEN



WHAT'S IN BETWEEN THESE

BOILERS BY BIGELOW

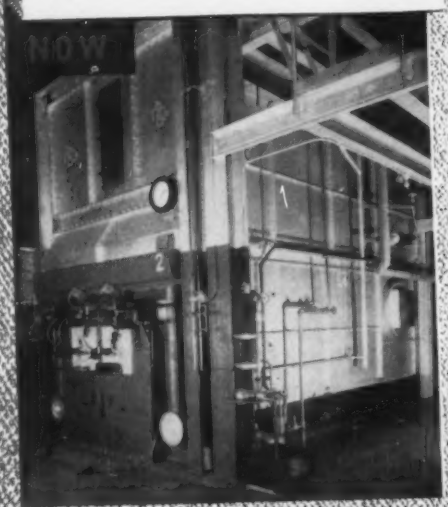
?

Between the two Bigelow boilers shown stands almost a century of boiler-making experience. During those years, Bigelow's reputation has been written in steam by thousands of successful, efficient and long-lived boiler installations all over the world.

What This Means To You

When you are in the market for a new boiler, you will benefit by what has happened in the time between these two boilers. You will get the advantage of the experience and progress in design, construction and inspection embodied in Boilers By Bigelow.

Write for free catalogs on any of the units listed.



THEN

This coal-fired boiler was one of the earliest Boilers By Bigelow.

NOW

Bigelow boiler installed recently at Waterbury Hospital, Waterbury, Conn. Capacity 23,000 lbs. steam per hour. Oil-fired.

Boilers By Bigelow

Water Tube Boilers — Bent Tube Types

Horizontal Return Tubular Boilers

Scotch Type Boilers

Two-Pass Boilers

Electric Steam Generators

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More POWER NEWS

Begins on page 154

Coming Events

Nov 10-12—Industrial Management Society, annual time and motion study and management clinic. Sherman Hotel, Chicago, Ill. Details from IMS, 35 E Wacker Drive, Chicago 1, Illinois.

Nov 18-20—Air-Conditioning and Refrigeration Institute, educational conference. Minneapolis, Minn. Details from ARI, 1346 Connecticut Ave NW, Washington, D. C.

Nov 29-Dec 2—First International Automation Exposition, 244th Regiment Armory, New York, N. Y. Details from IAE, 845 Ridge Ave, Pittsburgh 12, Pa.

Nov 29-Dec 3—American Society of Mechanical Engineers, annual meeting. Statler Hotel, New York. Details from ASME, 29 W 39th St, New York 18, N. Y.

Dec 2-7—21st National Exposition of Power and Mechanical Engineering. Commercial Museum, Philadelphia, Pa. Details from International Exposition Co, 480 Lexington Ave, New York 17, New York.

Jan 24-27—Plant Maintenance and Engineering Show, sixth exposition. International Amphitheatre, Chicago, Ill. Information from Clapp & Poliak Inc, 341 Madison Ave, New York 17, New York.

Jan 24-28—American Society of Heating and Ventilating Engineers, 61st annual meeting and 12th International Heating and Ventilating Exposition. Commercial Museum and Convention Hall, Philadelphia, Pa. Details from ASHVE, 62 Worth St, New York 13, New York.

Jan 26-28—Instrumentation for the Process Industries, tenth symposium. College Station, Texas. Details from School of Engineering, University of Texas, College Station, Texas.

Jan 31-Feb 4—American Institute of Electrical Engineers, winter general meeting. Statler Hotel, N. Y. Write AIEE, 33 W 39th St, New York 18, N. Y.

Theodore Maynz, well-known in the power field for his work with American Viscose Corp, is now available for consultation at 314 S Iseminger St, Philadelphia 7, Pa. He will specialize in generation and distribution of steam and electric power.

At American Viscose Corp, Mr Maynz handled electrical distribution and utilization problems for 15 years. Prior to that he had experience in both utility and industrial power fields, and as a consultant. He holds a BA degree from Harvard and ME and MA degrees from Columbia.

Southern Colorado Power Co has started construction of a $3 million steam generating plant tripling output of the present Canon City, Colo. plant.

HARBISON-WALKER'S

complete refractories service

—SIMPLIFIES YOUR ORDERING!
—REDUCES YOUR COSTS!

From Harbison-Walker you can obtain all the types and classes of refractories needed for all your furnace requirements. These provide the world's most complete refractories service—refractory brick and shapes, high temperature bonding mortars, plastics, castables and insulating materials for all service conditions and all applications.

The convenience of "one call" greatly simplifies your ordering procedure and frequently the economy of one large shipment instead of several small ones keeps transportation and handling costs to the minimum. The Harbison-Walker Engineering and Research Service Departments are maintained to help you make the most advantageous selection of refractories for every furnace need. These are practical cost-saving benefits.

HARBISON-WALKER REFRACTORIES CO.

AND SUBSIDIARIES

WORLD'S LARGEST PRODUCER OF REFRACTORIES

General Offices Pittsburgh 22, Pennsylvania

HARBISON-WALKER REFRACTORIES FOR POWER PLANTS

Harbison-Walker refractory products are used in power and heating plants of all types including those in the largest central power stations, in various manufacturing, industrial and commercial plants, and in hotels, office and other buildings. To meet the various requirements, Harbison-Walker produces fireclay and high-alumina refractories of all classes; insulating fire brick in many grades including those suitable for service at temperatures up to 3000°F.; plastic and castable refractories of all types; bonding mortars; basic refractories and monolithic materials for slag tap bottoms and paper mill recovery boilers.

Complete information and recommendations for specific requirements can be secured from the nearest Harbison-Walker district office or from headquarters at Pittsburgh, Pa.

SEE OUR EXHIBIT

Dec. 2-3-4-5-6-7, 1954

21st National Exposition of Power and Mechanical Engineering

Commercial Museum, Philadelphia

BELMONT PACKINGS

Service conditions are constantly becoming more extreme. The success or failure of a piece of industrial equipment is many times dependent upon whether or not it can be properly sealed against loss of pressure, liquids or gases. Belmont for over sixty years has kept pace with the ever changing demands, offering a wide scope of packing materials to satisfactorily meet the toughest services. You can get them *ALL from ONE SOURCE of SUPPLY.* Get in touch with your nearest stocking Belmont distributor or mail us your specifications. Write for new condensed catalog #54.

Belmont "Teflon"

For corrosive liquids—furnished in sheets, gaskets, rings, tape, plastic, molded bars and sleeves, extruded rods, spiral shapes, blue asbestos and white asbestos suspensoid.

Belmont "O" Rings

Made to close tolerance from synthetic and natural rubber, "Teflon", Silicone, for dynamic and static seal applications working against air, oil, steam, water, acids.

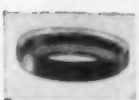
Belmont Rod Packings

Like the one illustrated (Belmont 30), our many constructions have special features dependent upon services—asbestos, rubber and duck, plastic, metals, flax, jute, cotton, ramie.

Belmont Gaskets

Woven asbestos boiler manhole and handhole; rubber and synthetic molded, extruded, die or lathe cut; compressed asbestos; vegetable fibre.

Belmont Leather Packings



Cup, flange, U and V shaped and washers in special tannages and treatments as service warrants.

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17 **Distribution and service** connectors, copper and aluminum, compression and bolted. Sketches, installation drawings, charts in 22-page bulletin 71. Thomas & Betts Co, Inc, Elizabeth 1, New Jersey.

18 **Electric motors.** Multi-color booklet describes company's 20 principal types of motors. Bulletin 1878, U.S. Electrical Motors Inc, Box 2058, Los Angeles 54, Calif.

19 **Soldersealed potheads.** Publication C-79-1330 describes complete line. Photos, tables, dimensions. Anaconda Wire & Cable Co, 25 Broadway, New York, N. Y.

INSULATION

20 **Asbestos electrical insulations.** Three descriptive sample folders; Folder EL-54A covers *Quinterra type 3-GR,* a Class H insulation for temperatures to 250 C; Folder EL-49A, *Quinterra Type 5-GR* and *Type 5-GL,* Class B for temperatures to 150 C; Folder EL-55A, *Quinorgo No. 4000-GR* and *No. 4000-GL,* Class B insulation. Samples for testing and experimentation included. Specify folder desired. Johns-Manville, 22 E 40th St, New York 16, N. Y.

21 **Aluminum jacketing** for weatherproofing insulated lines, towers, vessels, tanks. Detailed drawings, application data in 4-page bulletin J-25. Childers Manufacturing Co, Box 7447, Houston 8, Texas.

22 **Insulation material** for wire and tubing. Charts, specs in 44-page bulletin 54. William Brand & Co, Inc, Willimantic, Conn.

SAFETY AND MAINTENANCE

23 **Safety and rescue equipment** for industrial plants. Twelve-page booklet entitled "Disaster" gives information on choosing proper equipment. Booklet 5000-4. Mine Safety Appliances Co, 201 N Braddock Ave, Pittsburgh 8, Pennsylvania.

24 **Fire extinguishing systems.** Electrically-operated, automatic carbon dioxide units. Diagrams, sketches in 12-page bulletin. Walter Kidde & Co, Inc, Belleville 9, N. J.

25 **Scaffolding.** Applications and fittings described and illustrated in 6-page bulletin 501. Amidon Sales Co, Box 61, Elyria, Ohio.

26 **Filters** for cleaning hot, wet and corrosive gases and air. Photos, drawings, descriptive data in 8-page bulletin 4. Mechanical Industries, Inc, 950 Grogan Bldg, Pittsburgh 22, Pa.

27 **Industrial packings.** Descriptions of 121 styles for all services. Technical data, recommendations in 42-page catalog. The Hollow Center Packing Co, 6523 Euclid Ave, Cleveland 3, Ohio.

28 **Packing lubricant,** *Lupac,* for continuous lubrication for packings of all kinds. Four-page bulletin. The Hollow Center Packing Co, 6523 Euclid Ave, Cleveland 3, Ohio.

29 **Packings and gaskets.** Fibrous and metal in spiral, coil and ring form. Also asbestos, fibre and rubber sheet packing and gaskets. Four-page bulletin. Standard Packings Co, 6523 Euclid Ave, Cleveland 3, Ohio.

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32 **Rubber-base paint,** *Grade RA,* for corrosion resistant, protective coatings. Six-page, 3½x8½ descriptive folder and 2-page reprint. Alfred Hague and Company, 227 34th St, Brooklyn 32, New York.

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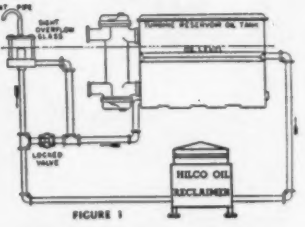

FIGURE 1

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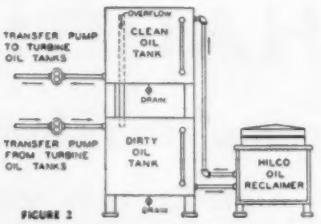

FIGURE 2

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Next Steps in Atomic Progress . . . A Challenge to American Industry

The purpose of this editorial is to throw light on the significance for American industry of recent changes in the statutes that control the development of atomic energy.

The need for clear light on the meaning of this new legislation is made more urgent by the political confusion and distortion that marked its course through Congress. The politically inspired charges of "giveaway" that delayed its passage—charges that were almost totally unrelated to the legislation itself—helped to obscure the vital importance of the step finally taken by Congress.

In sober, post-Congressional fact, the principal significance of the new atomic legislation is that it extends to private enterprise responsibility for the development of peaceful uses of atomic energy, whereas heretofore this responsibility has rested in a tight government monopoly. **And this extension is made on terms that emphasize the responsibility far more than they open any opportunity for economic gain in fulfilling it.** The revised Atomic Energy Act provides that:

1. Industry may now own and operate its own nuclear reactors, under license from the Atomic Energy Commission. And it may build and sell nuclear reactors for export.

2. Industry may use—but not own—nuclear materials at the discretion of the Atomic Energy Commission.

3. The Atomic Energy Commission will make available to industry scientific knowledge that may be useful in developing peaceful applications of nuclear energy.

4. For the first time, industry will have the right to patent inventions in the field of nonmilitary nuclear energy. However, "basic" discoveries must be made available to all companies in the field for a period of five years, after which they, too, will revert to normal patent status.

Two Kinds of Know-How

These provisions, despite the imposed limitations, represent the first positive step toward development of nuclear energy for peaceful applications in the United States. Potentially useful knowledge, previously locked in the minds of government scientists, will now be available to all those who are willing and able to put it to work for the good of mankind.

The advantages to be gained from enlisting the talents of American industry in the development of peaceful atomic applications are imposing. As *The* (London) *Economist*, Europe's leading economic journal, recently remarked, "The atomic scientists are in a position to surmise how atomic energy can be applied... but they lack the specialized knowledge of engineering design and operating technique just as industry itself lacks atomic knowledge." Now the engineers of private industry need no longer lack the atomic knowledge, and there is granted to them at least a restricted freedom to apply it to the solution of their engineering and operating problems.

But the new opportunity for private industry to find constructive uses for the science of nucleonics carries with it a grave responsibility. These uses must be so developed that they will benefit the people of all the free nations. It is essential that the United States, which pioneered in developing lethal uses for atomic fission, demonstrate to the world our paramount interest in its peaceful application. It would be a moral set-back to the free world almost beyond calculation if the Communists should be able to offer to the poorer nations of the world the benefit of low cost atomic power—provided by Communist technicians—while we concentrate primarily on building our stockpile of atomic and hydrogen bombs.

Race For a Peaceful Victory

Most of the experts are agreed that it may be many years—perhaps ten, fifteen or more—before the cost of electricity from atomic fission can be reduced to a level that will make it competitive with conventionally produced power in most regions of the United States. But most of the world is not nearly so fortunate as we are in power resources. Electricity, even at a cost far higher than the average that prevails in the United States, would be a blessing in many countries, and the nation that provides the technology to bring it into being will score a great moral victory.

The useful potential of nuclear energy is not restricted to the generation of electric power—although twenty years from now this use will be highly important to the power industry of the United States. Even with the limited research that has been done in this field thus far, the use of radioisotopes—the radioactive products of atomic reactors—is saving American industry an estimated $100 million a year. Commissioner Campbell of the AEC, who made this estimate, believes that these savings may well reach $1 billion a year within ten years. Radioisotopes are already at work in industries ranging all the way from paper manufacturing, where they measure paper thickness, to pipeline transportation, where they mark the dividing lines between shipments of different products (at an estimated saving of $500,000 a year). Medical applications of these same radioisotopes hold promise of longer and more comfortable lives for those who are stricken by cancer and other diseases.

Above All a Challenge

The new Atomic Energy Act is a crucial stride toward the day when all these benefits—and undoubtedly others not yet revealed by research—will be realized. But it is a step that is essentially permissive. It still leaves it to private industry for the most part to decide what is to be done and how soon.

The new act is thus, above all, a challenge. It confers on private industry the responsibility to assume a leading role in the development of peaceful uses for nuclear energy, a step long urged by NUCLEONICS, a McGraw-Hill magazine devoted to atomic energy. To achieve a success in this task that will measure up to the requirement of the national interest, this development must command all the resources and ingenuity that private enterprise can apply—and do so without promise of glittering prizes surely to be won. **But now that the responsibility has been defined and the challenge offered, American industry will, we believe, measure up to its grave and mighty import.**

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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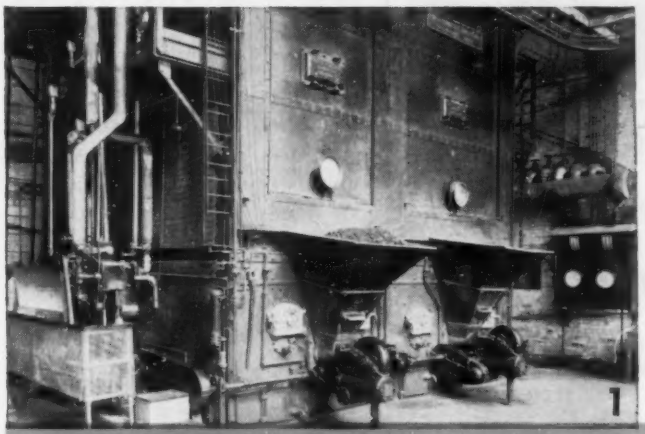
27 YEARS DEPENDABLE OPERATION

with Detroit Single Retort Stokers in the Cleveland Graphite Bronze Company

(Central Ave. Plant)



These old Detroit Single Retort Stokers have been operating for more than a quarter of a century and are still in excellent condition, giving satisfaction to the owners. Another typical example of Detroit Stoker durability.

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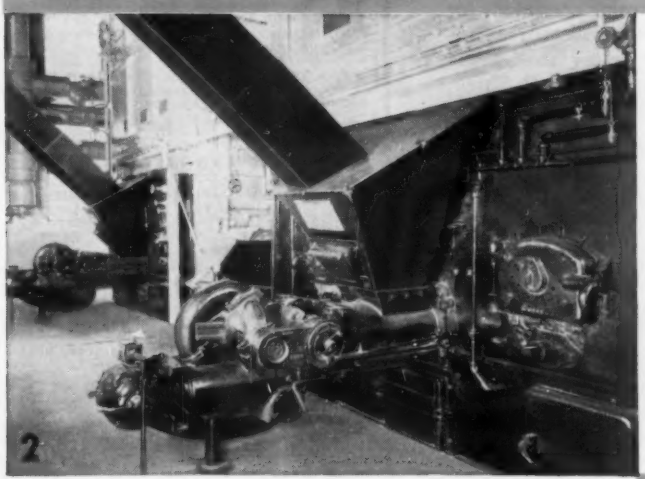

1. Steam engine driven Detroit Single Retort Stokers installed in 1927 at Cleveland Graphite Bronze Company Boiler Plant. Still giving efficient service.

2. Latest type Detroit Single Retort Stokers, individually motor driven, with Detroit Adjustable Feed Controls at Mumford High School, Detroit.

3. Detroit Adjustable Feed (Coal Feed Control) provides many rates of coal feed . . . is regulated either manually or automatically. Air supply from separate fan is properly proportioned to the coal feed for maximum efficiency at all capacities.

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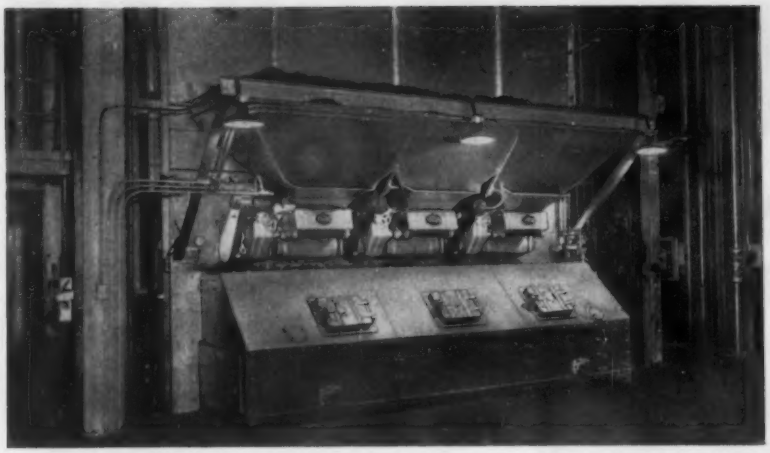

Shown here is a Bros Travl-Spred Stoker installation at a large midwestern university. Heat for campus buildings is produced by a unit comprising Bros Travl-Spred Stokers and Bros Watertube Boilers.

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Hague & Co, 227 34th St, Brooklyn 32, New York.

33 **Pipe wrenches,** cutters, vises. Photos, descriptions, specs in 8-page bulletin 9. Trimont Manufacturing Co, 50 Frank St, Worcester 4, Mass.

34 **Industrial flooring,** said to produce iron-clad surface that is static-disseminating, spark-resistant and noncombustible. Eleven-page bulletin 38. The Master Builders Co, 7016 Euclid Ave, Cleveland 3, Ohio.

MATERIALS HANDLING

35 **Bulk pneumatic handling** for dry pulverized materials. Photos, applications, recommendations of proper systems. Sixteen-page bulletin G-2. Fuller Co, Catasauqua, Pa.

36 **Sectional belt conveyors.** Description of complete components for customer assembly. Four-page bulletin 1454. Standard Products Div, Stephens-Adamson Mfg Co, Aurora, Ill.

MECHANICAL TRANSMISSION

37 **Speed reducers,** shaft mounted. Dimensional drawings, tables, charts in 8-page bulletin CD-323. Cone-Drive Gears Div, Michigan Tool Co, 7171 E. McNichols Rd, Detroit 12, Mich.

★ **Multi-V belts.** Horsepower rating tables, selection, installation, maintenance data in 76-page handbook. *Request direct on company letterhead from B F Goodrich Co, Industrial Products Div, Akron, Ohio.

38 **Shaft mounted drives** for input speeds between 420 and 10 rpm in ½ to 30 hp range. Design data, selection tables, dimensions, photos in 8-page bulletin 7101. The Falk Corp, 3001 W Canal St, Milwaukee 8, Wis.

39 **Transmission belt,** *Poly-V drive,* described in 8-page folder 6638. Manhattan Rubber Div, Raybestos-Manhattan, Inc, Passaic, New Jersey.

40 **Shaft couplings** rated from ¾ to 1500 hp. Dimensions, weights, safety factors described in 4-page bulletin 28. Brown Engineering Co, 23 N 3rd St, Reading, Pa.

METERS AND INSTRUMENTS

41 **Pressure recorders.** Description of company's full line in illustrated 24-page bulletin 6-10. The Foxboro Co, Foxboro, Mass.

42 **Liquid level gages.** Design and construction data, drawings, charts, photos in 8-page bulletin 246. Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

43 **Vibrating reed tachometers,** portable and stationary types. Four-page bulletin 770-A. Herman H Sticht Co, 27 Park Pl, New York 7, N. Y.

44 **Recording oscillograph.** Photos, applications in 12-page bulletin CEC-1521A. Consolidated Engineering Corp, 300 N Sierra Madre Villa, Pasadena 15, Calif.

45 **Tube draft gages,** inclined and vertical types. Photos, diagrams, specs in 20-page bulletin 109A. Ellison Draft Gage Co, Inc, 548 W Monroe St, Chicago 6, Ill.

46 **Gas purifiers** for catalytic purification, hydrogenation and oxidation of gases. Photos, descriptions of eight units in 6-page bulletin. Baker & Co, Inc, 113 Astor St, Newark 5, N. J.

47 **Measuring and control** equipment for water and sewage works, power and processing industries. Brief descriptions on venturi tubes, parabolic flumes, air release and air inlet valves, flow rate controllers. Four-page bulletin 050. Simplex Valve & Meter Co, 68th & Upland Sts, Philadelphia 42, Pa.

VALVES, PIPING, FITTINGS

48 **Valves.** Foot, 4-way hand, power, pilot and solenoid valves de-

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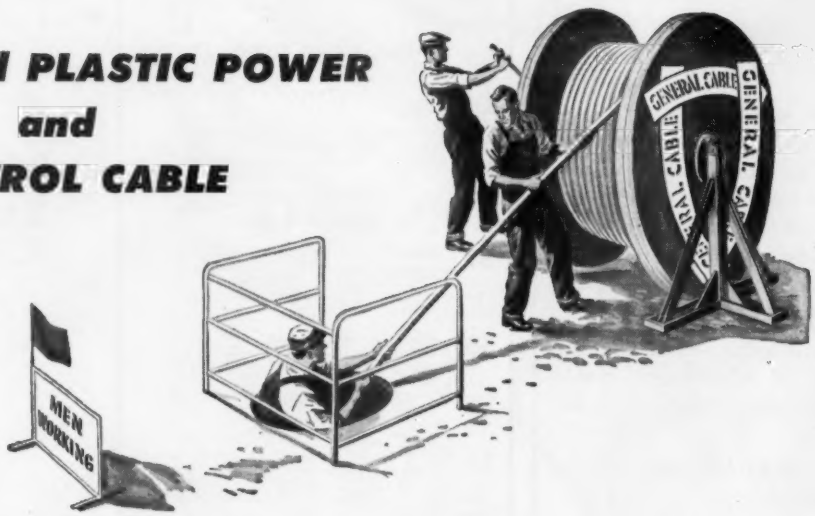

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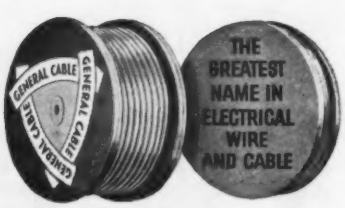

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scribed in 16-page bulletin 1010. Dimensions, application and circuit diagrams. Ledeen Manufacturing Co, 1600 S San Pedro St, Los Angeles 15, Calif.

49 **"Choosing the Right Valve,"** a 20-page illustrated pamphlet. Photos, cutaways, informational data on characteristics and designs. Crane Co, 836 S Michigan Ave, Chicago 5, Illinois.

50 **Air release valves.** Purpose, applications, specs in 2-page data sheet 654. V D Anderson Co, 1935 W 96th St, Cleveland, Ohio.

51 **Needle and globe valves.** Schematic drawings, specs in 4-page bulletin. Associated Valve & Engineering Co, 1150 W Marquette Rd, Chicago 21, Illinois.

52 **Relief valves and strainers.** Photos, design and dimensional details, installation and maintenance data in 8-page bulletin 12-T. Edward Valves, Inc, 1201 W 145th St, E Chicago, Ind.

53 **Hot extrusions.** Descriptions and advantages in 4-page catalog. Allegheny Ludlum Steel Corp, 2020 Oliver Bldg, Pittsburgh 22, Pa.

54 **Precision castings.** Eight-page bulletin describes frozen mercury process. Photos, charts and drawings. Mercast Corp, 295 Madison Ave, New York 17, N. Y.

55 **Tubing, piping, fittings.** Twenty-page bulletin 5 provides stock lists, availability data and application details. A B Murray Co, Inc, Box 476, Elizabeth B, N. J.

56 **Water jet eductors.** Design, construction, operation in 36-page bulletin 2-M. Schutte & Koerting Co, Dept J-M, Cornwell Heights, Bucks County, Pennsylvania.

PRIME MOVERS

57 **Steam turbine trends** discussed in 8-page reprint folder 03R8182. Photos, cutaways, diagrams. Allis-Chalmers Manufacturing Co, 952 S 70th St, Milwaukee, Wis.

58 **Gas turbines** for gas pipeline pumping, 6700 hp, 5400 rpm at 1000 ft altitude and 80 F ambient. Two-color, 12-page booklet GEA-5962. General Electric Co, Schenectady 5, N. Y.

PUMPS

59 **Diffusion pumps.** Speeds, pressures, operating charts in descriptive bulletin. Naresco Equipment Corp, 160 Charlemont St, Newton Highlands 61, Mass.

60 **Vertical pumps** for handling hydrocarbons, hot or cold water, mild acids, basic and salt solutions. Photos, diagrams construction features in 12-page bulletin B-1700. Peerless Pump Div, Food Machinery & Chemical Corp, 301 West Ave 26, Los Angeles 31, California.

61 **Variable delivery pumps,** *Type A,* up to 3 hp. Diagrams, photos, specs in 8-page bulletin 47010. The Oilgear Co, 1564C W Pierce St, Milwaukee 4, Wisconsin.

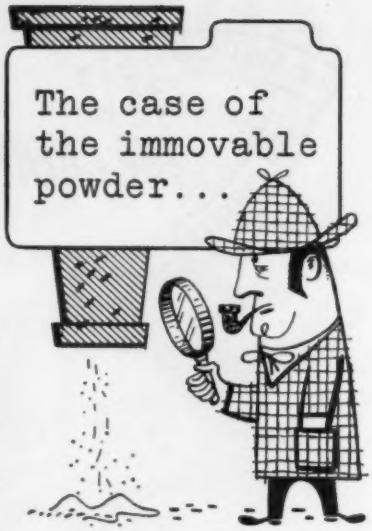
62 **Controlled volume pumps.** Illustrated 24-page booklet 1253 describes how units may be used as flow controllers, ratio controllers and final control elements in process instrumentation. Milton Roy Co, Station Y, 1300 E Mermaid Lane, Philadelphia 18, Pa.

63 **Proportioning pumps,** *"A" Series.* Applications, diagrams, design features in 6-page bulletin AP-54. Hills-McCanna Co, 3025 N Western Ave, Chicago 18, Illinois.

WATER TREATMENT

64 **Pressure filters.** Specs, operating characteristics, outline dimensions, photos in 16-page bulletin 2225-B. Permutit Co, 330 W 42nd St, New York 36, New York.

(Continued on page 242)



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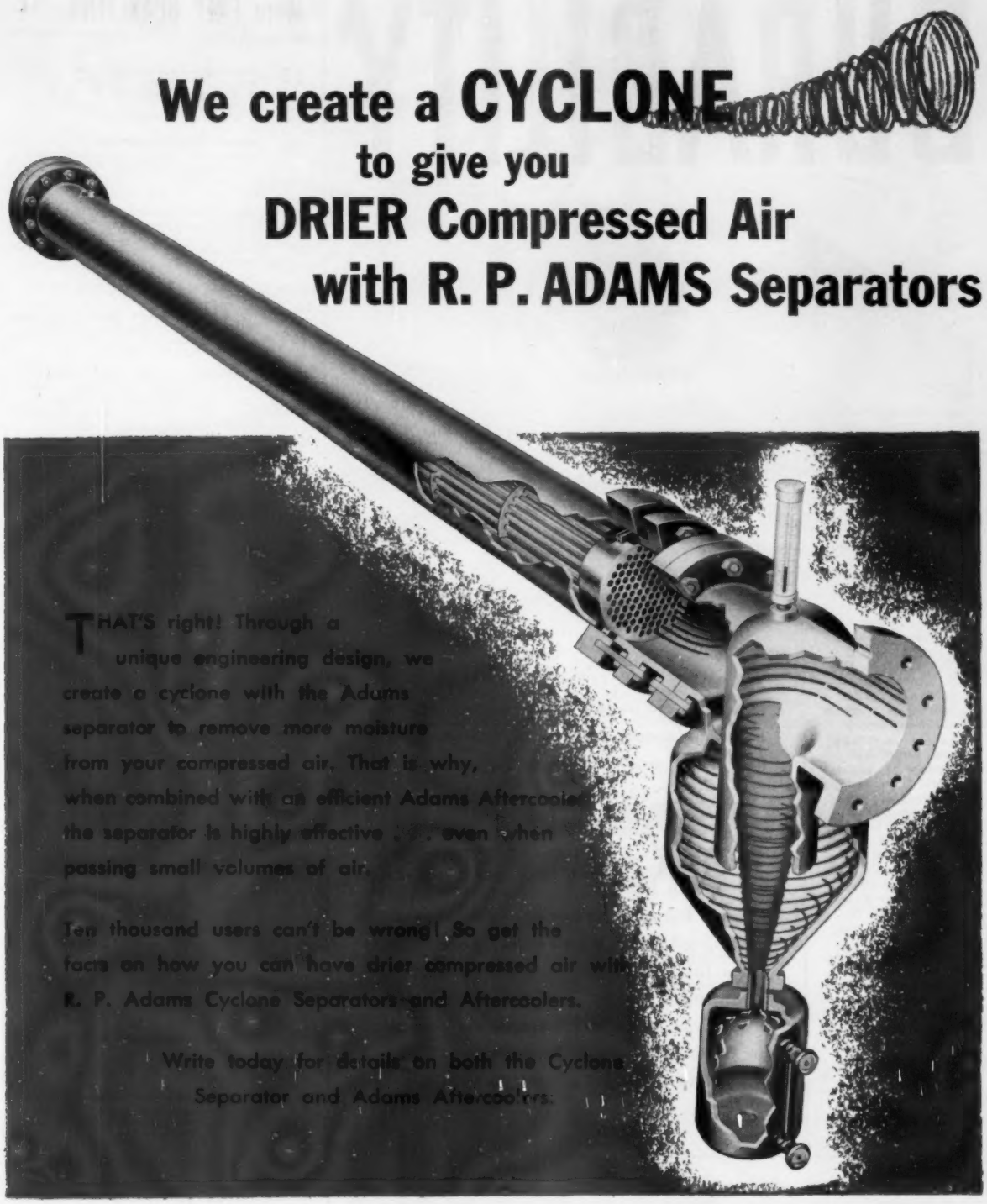

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65 **Testing equipment** for control water analyses. Photos, descriptions in 12-page bulletin. W H & L D Betz, Gillingham & Worth Sts, Philadelphia 24, Pennsylvania.

66 **Anion exchange resin.** Nature and operating characteristics, charts, specs in 14-page bulletin 31. Chemical Process Co, Box 829, Redwood City, California.

67 **Water softeners** for industrial and municipal operations. Photos, cutaway in 4-page bulletin 211. Industrial Filter & Pump Mfg Co, 5900 Ogden Ave, Chicago 50, Ill.

HEAT EXCHANGERS

68 **Heat exchangers,** fixed tube bundle *type F.* Photos, cutaways, charts in 12-page bulletin 1254. Young Radiator Co, Racine, Wis.

69 **Condenser and heat exchanger** tubes. Photos, diagrams, charts in 20-page bulletin. Phelps Dodge Copper Products Corp, 40 Wall St, New York 5, New York.

METALS AND ALLOYS

70 **Porous chromium** plate, processed to hold oil and other lubricants, explained in 12-page illustrated booklet. Metal can be used for steam cylinders, valve bushings, compressor cylinders and plungers. Van Der Horst Co, Olean, N. Y.

71 **Data card presents** stress rupture information on eleven tubing steels used in high temperature service. Card TDC 153-A. Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

WELDING

72 **Hand torches** for gas cutting and welding. Illustrations, charts, descriptions in 36-page catalog ADC 702B. Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.

73 **Arc welding electrodes.** Application, descriptive engineering data in 30-page bulletin. Metal & Thermit Corp, 100 E 42nd St, New York 17, N. Y.

74 **Brazing manual,** how-to booklet contains data for brazing shapes, sheet, castings, tubing and assemblies. Illustrated 24-page, 4x7-in. catalog. All-State Welding Alloys Co, Inc. 249-55 Ferris Ave, White Plains, New York.

75 **Cutting and welding** products. Condensed 52-page catalog describes and illustrates company's products used in light welding and cutting. Bulletin ADC 662B, Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.

76 **Comparison chart** on hard-facing rods and electrodes. Mir-O-Col Alloy Co, Inc, 312 N Ave 21, Los Angeles 31, California.

77 **Welding problems and techniques.** Illustrated 8-page how-to booklet. Eutectic Welding Alloys Corp, 40-40 172nd St, Flushing 58, New York.

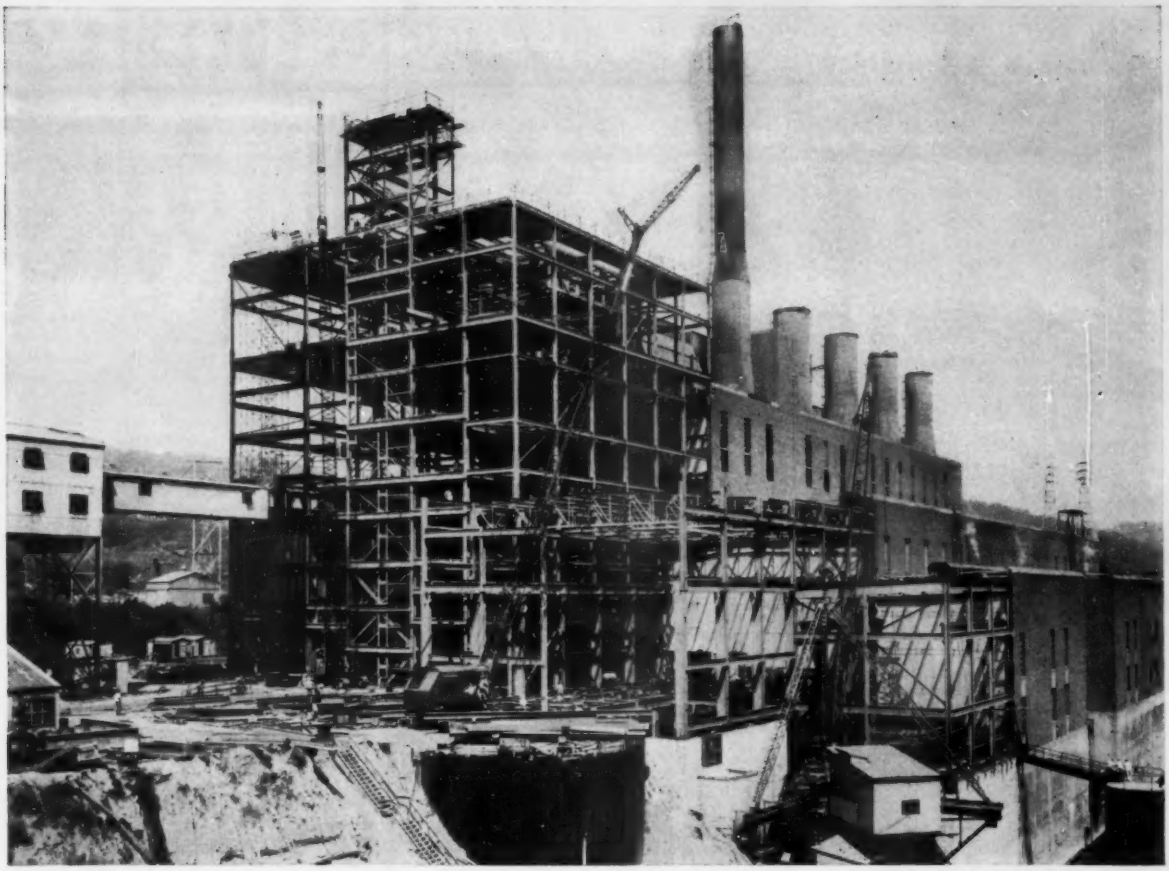
78 **Low-temperature brazing.** Photos, applications in 4-page bulletin 66. Handy & Harman, 82 Fulton St, New York 38, New York.

MISCELLANEOUS EQUIPMENT

79 **Portable incinerators** for up to 450 lbs average waste per hr. Photos, features in 8-page bulletin 65. Pilbrico Co, 1800 N Kingsbury St, Chicago 14, Illinois.

★ **Vibrating equipment.** Illustrated 230-page catalog describes company's full line. Catalog 870. *Request direct on company letterhead from The Jeffrey Manufacturing Co, Columbus 16, Ohio.

80 **Storage tanks.** Specs, design data, foundation recommendations of steel plate units. Illustrated 24-page catalog 54B. Hammond Iron Works, 630 5th Ave, New York 20, New York.



Another Addition for Duquesne Light

. . . under construction by DRAVO

The addition for the largest single generating unit in Duquesne Light Company's entire system is now being constructed by Dravo at the Frank R. Phillips Power Station, Wireton, Pa.

This new 150,000 kw unit is completely independent of the rest of the station. It uses a high-pressure 1,170,000-lb/hr boiler that consumes over 60 tons of coal per hour. To house the new unit requires a structure the size of a modern office building. When completed in 1955 the Phillips station will have an output capacity in excess of 380,000 kw.

This is the third addition which Dravo, working under the direction of Duquesne Light Company's Engineering and Construction Division, has built to the Phillips Station since 1947. It is just another example of Dravo's versatility in performing a wide range of construction assignments such as boiler plants, water-pumping stations, oil or gas pipeline transmission facilities, water and waste treatment plants.

Let Dravo be your "Construction Department." Find out how you can profit through Dravo's single-contract service. Write for complete information and ask for Bulletin No. 1200. Dravo Corporation, Machinery Division, Fifth and Liberty Avenues, Pittsburgh 22, Penna.

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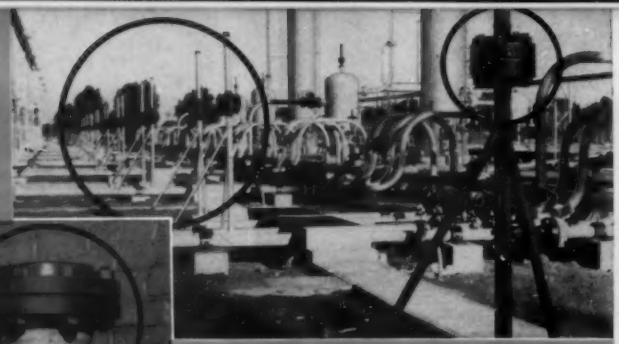
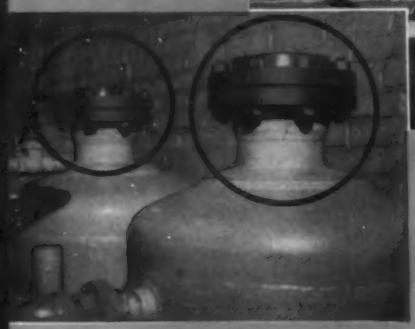
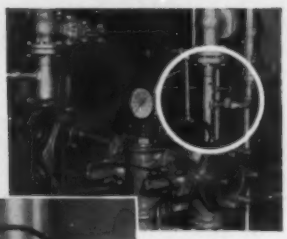


BS&B Safety Heads protect compressor lines at a South Texas condensate recovery—pressure maintenance plant.



Equipment and personnel within a plant are protected from the hazards of overpressure in these vessels by BS&B Safety Heads.

BS&B Safety Heads Have Hundreds of Applications!

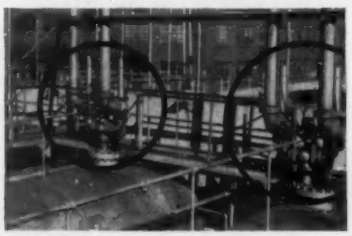


Here a BS&B Union Type Safety Head, with Monel rupture disc, is installed on a two-stage hydrogen compressor.

This BS&B Safety Head is mounted on the flare from a Pop Valve on an incoming gas line.

The variety of possible uses for BS&B Safety Heads is limited only by the number of different ways in which compressed air, gas or liquids—either bland or corrosive—are handled, processed or stored by our many manufacturing and processing industries! Wherever protection of a closed pressure system is required, there is a correct size and type of BS&B Safety Head to do the job! For detailed information, ask your BS&B Representative . . . or write to us direct.

THE "CIRCUIT-BREAKER" OF *Any Pressured System*



BS&B Combination Safety Head—Relief Valves protect 15,000 gallon butadiene storage tanks at an Akron, Ohio, rubber plant.

BLACK SIVALLS & BRYSON, INC.

Safety Head Division, Dept 2-Q11
7500 East 12th St., Kansas City 26, Mo.

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY

BOOKSHELF

Principles of Engineering Thermodynamics. *Second edition. (1954). By Paul J Kiefer, professor of mechanical engineering, U.S. Naval Postgraduate School, Gilbert Ford Kinney, professor of chemical engineering, U.S. Naval Postgraduate School, and Milton C Stuart, professor of mechanical engineering, Lehigh University. 6x9¼, cloth, 539 pp, diagrams, charts, tables. $7.75. John Wiley & Sons, Inc, 440 4th Ave, New York 16, N. Y.*

Almost completely rewritten, this book covers the thermodynamic basis of fluid mechanics and aerodynamics. It unifies mechanical, chemical and aerodynamic applications in an up-to-date manner that is directly applicable to current engineering practice. The book emphasizes principles of engineering thermodynamics and points out the ideal capabilities and limitations of power plant and similar equipment.

As in the earlier edition, the book makes definite distinction between energies stored in as matter and those in transition as heat. Other features retained are: introduction of steady-flow energy equation and the enthalpy function; and an emphasis on the entropy of energy and the entropy function as an index of mechanical unavailability.

With almost exclusive use of turbo-type machinery and its attendant high-velocity flow, it has been necessary to supplement the steady-flow equation to provide more specifically for influence of frictional effects. A simple but adequate dynamic equation is developed for this purpose. A new type of flow chart is introduced which greatly eases the study of thermodynamics of compressible flow. Another new item is the development of simple but valid means for accounting for the variation of specific heats of gases with temperature.

Techniques of Plant Maintenance and Engineering, 1954. *Proceedings of the technical sessions held concurrently with the Fifth National Plant Maintenance and Engineering Show, Chicago, Jan, 1954. 8x11, 291 pp, illust, $7.50. Clapp & Poliak, Inc, 341 Madison Ave, New York, N. Y.*

Includes text of all the prepared papers presented and complete transcripts of the question and answer sessions that followed. Also summarizes 20 round-table discussions held by smaller groups on special maintenance problems.

Rotating Electrical Machinery. *8½ x 11, $3.50. Book adapted from a manual used by the Navy in training electrical and electronic technicians. Crow Electri-Craft Corp, 1102 Shelby St, Vincennes, Indiana.*

High-school teachers looking for a practical, simplified approach to the teaching of ac and dc machinery will find this text of value. When coordinated with the Crow Electric-Kit *Model 700*, this manual is designed and illustrated so an instructor with the minimum electrical background can handle the course.

Virtually no mathematics is used. The student builds assemblies that perform somewhat like commercial machines with

For low-cost, dependable steam, Upjohn burns coal the modern way

Upjohn has long been famous as a manufacturer of pharmaceutical products. Because of the nature of these products, it was necessary that the steam plant of Upjohn's new Portage Road Plant, near Kalamazoo, Michigan, operate cleanly as well as economically. Therefore, coal was chosen to fire its boilers.

Today Upjohn's ultramodern steam plant supplies steam at only 40c to 42c per 1,000 pounds. It is clean and efficient, with no dust or smoke nuisances, and ash handling is fully automatic. At peak load, the three boilers shown above, plus a fourth recently installed, deliver up to 115,000 lbs. of steam per hour.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

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Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

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More BOOKSHELF

Begins on page 244

the manual guiding him each step of the way. Written at the sophomore level, the manual's 256 pp feature over 300 sketches and diagrams showing the student exactly what parts he needs, how to set the machine up and the practical application of what he has built.

Handbook of Industrial Safety Standards. *(Ninth revision). 315 pp, 5¼ x 8, $1.40. A publication of the Accident Prevention Dept, Association of Casualty and Surety Companies, 60 John St, New York 38, New York.*

Handbook is a concise compilation of industrial safety requirements recommended by nationally recognized authorities including the American Standards Association, National Fire Protection Association, ASME, and various governmental organizations. However, much of the text is an amplification and extension of the codes on which it is based, and some sections deal entirely with topics not covered by existing standards.

Subjects covered include safety programs, sanitation, hand tools, materials handling, elevators, boilers, unfired pressure vessels, engines and turbines, welding and cutting, mechanical power transmission equipment, machinery guards, storage and handling of flammable liquids, electrical equipment, disaster control.

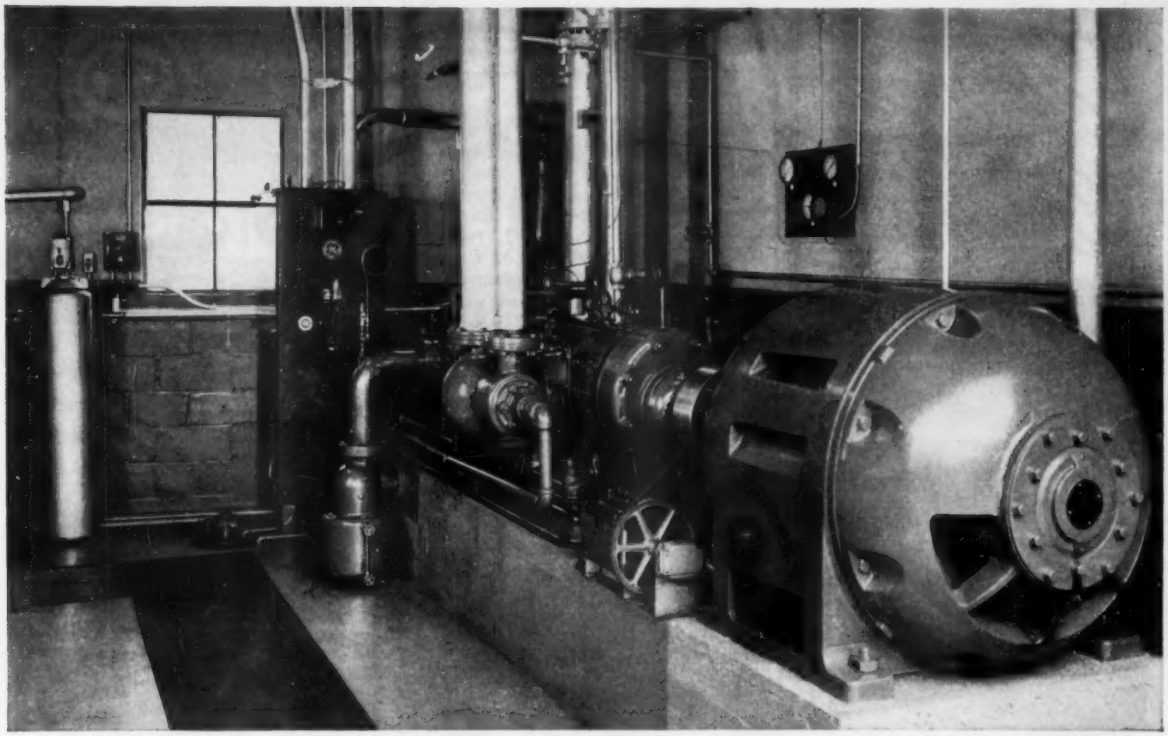
Designed for plant administrators, safety directors, engineers and training instructors, the revised edition of this handbook is 50% larger than the previous edition. Safety codes that are especially applicable to the subject matter are listed at the end of most chapters.

Alternating-Current Machines. *(Third edition). By A F Puchstein, consulting engineer, The Jeffrey Mfg Co; T C Lloyd, chief engineer, Robbins and Myers Inc; A G Conrad, chairman, dept of electrical engineering, Yale University. 721 pp, 6 x 9, $8.50. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Form of this text has not been changed greatly in the revision. However, approaches to some machine theory have been modified. Those acquainted with previous editions will note significant changes in the more detailed developments of equivalent circuits, vector diagrams, methods for calculating the cross-axis voltages of synchronous machines and equations describing oscillations of synchronous motors.

Beginning with transformers, this widely used book shows how to understand, test, predict, and calculate behavior and performance of the more important types of ac power machinery.

Official name of the trade show formerly known as All-Industry Refrigeration and Air Conditioning Exposition has been changed. Next show sponsored by ARI will be known as 9th Exposition of the Air Conditioning and Refrigeration Industry. It is scheduled for Atlantic City on Nov 28 through Dec 1, 1955.



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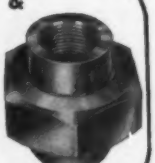
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



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APPOINTMENTS

Corporation executive changes

A M Byers Co: A B Drastrup, president. **Bell & Gossett Co:** W A Boone, H A Lockhart, C R Smith and R A Marquardt, vice-presidents. **Borg-Warner Corp,** Ingersoll Steel div: Stephen L Ingersoll, executive vice-president; Harold G Ingersoll Jr, vice-president and secretary. **Burns & Roe Inc:** Kenneth A Roe, executive vice-president. **York Corp:** Ray K Serfass and J M L Joslin, vice-presidents.

American Gas & Electric Service Corp: H B Cohn, vice-president. **American Brake Shoe Co:** Edward R Anderson, vice-president; J Robert Pauline, vice-president of Kellogg div. **Gothard Manufacturing Co:** William A Gothard, president. **A P Green Fire Brick Co:** H B Plunkett, executive vice-president. **Rockland Light & Power Co:** A H Palmatier and Charles W Caldwell, vice-presidents. **Southern California Edison Co:** H W Tice, senior vice-president; James F Davenport, vice-president and general manager. **Durant International Corp:** William R Funk, president.

Operations executive changes

The Youngstown Sheet & Tube Co: Henry A Holberson, vice-president and general manager of Youngstown Metal Products Co, a subsidiary. **Idaho Power Co:** John T Kimball, vice-president and general manager. **Laclede-Christy Co:** W L Fabianic, vice-president, research and quality control; P K Nichols, vice-president, operations. **Fluor Corporation Ltd:** Dr William R Hainsworth, vice-president, research.

Hubbard & Co: Howard Jackson, vice-president, production. Charles S Kernaghan, vice-president, merchandising. **American Brake Shoe Co,** National Bearing div: Norman Birch, vice-president, operations; I Eugene Cox, vice-president, engineering and development; Bernard Esarey, works manager of Meadville, Pa. plant.

Minneapolis-Honeywell Regulator Co, Brown Instruments div: John H Hagen, director of industrial relations. **Thermoid Co:** Robert Keach, manager of industrial rubber div. **General Electric Co,** capacitor dept: Lucas P Hart Jr, manager of manufacturing. **Worthington Corp:** Edward R Maddock, manager of Decatur, Ala. works.

Le Roi Co: Ray H Rodolf, general manager, compressor div; Herschel V Hiatt, general manager, engine div. **National Research Corp:** Sydney Minault, works manager of production and engineering depts, equipment div. **The Gas Machinery Co,** industrial furnace div: Charles H Schwerin, manager. **Barry Corp:** Harold Wrigley, works manager; Charles S Basney, new products manager.

New district managers

The Babcock & Wilcox Co: Ralph K Behr, Boston, boiler div. **Link-Belt Co:** Gene A Zwerner, Washington, D.C. **Sterling Electric Motors Inc:** Richard J Zobel, Philadelphia. **Frick Co:** Hugo Reichen-

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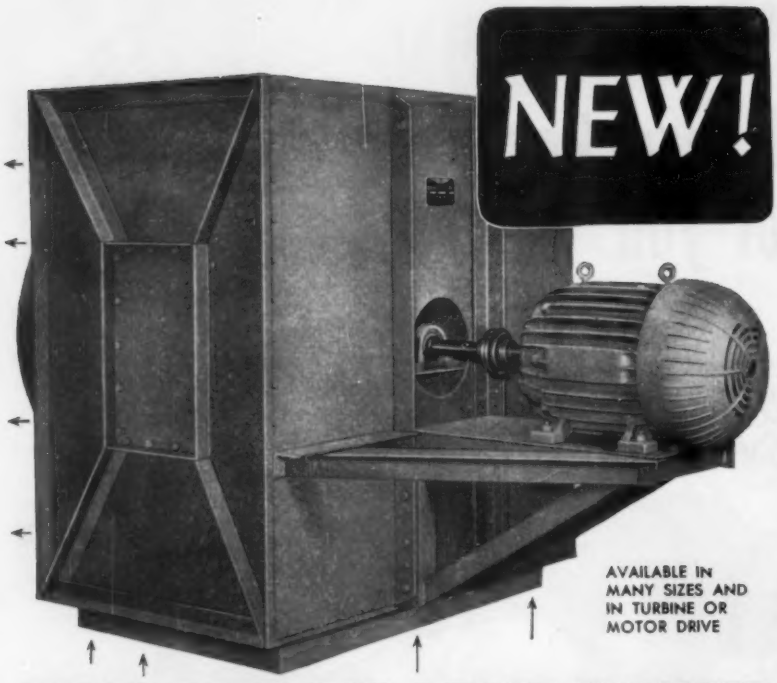

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OUR 75TH YEAR 1879

Wing

More APPOINTMENTS

Begins on page 248

bach, St Louis. **Graybar Electric Co:** H D Epps, Pittsburgh; C A Rettenmayer, Minneapolis, replacing A C Wehman, retiring; F P Hoeffler, St Louis.

Consolidated Engineering Corp, CEC Instruments Inc: Frank E Chase, New York. **Lincoln Electric Co:** Robert J Hirsch, North Haven, Conn. **General Dynamics Corp,** Electro Dynamic div; Allan B Collins, Kansas City, Mo. **Federal Pacific Electric Co:** James J Dugan, Detroit. **Raybestos-Manhattan Inc,** Manhattan Rubber div: Frank A McBrearity, Philadelphia. **Philip Carey Mfg Co:** J W Bartlett, Cincinnati, succeeding W H Skinner, retiring.

Engineer changes

Stone & Webster Engineering Corp: Olcott L Hooper, chief hydraulic engineer and head of hydraulic div; Thomas A Fearnside, chief mechanical engineer and head of mechanical div; Leslie O Waite, chief electrical engineer and head of electrical div. **H K Porter Co, Inc,** Quaker Rubber Corp: Joseph Cleary, plant engineer. **Sintercast Corp of America:** Robert E W Harrison, director of special engineering projects. **The Lukenheimer Co:** Marvin L Steinbuch, chief metallurgist and research director, succeeding John W Bolton, retired.

General Electric Co: Robert L Bell, manager of manufacturing engineering, carboloy dept; Harold J Chase, manager, engineering, small turbine and supercharger dept. **Beckman Instruments Inc,** Beckman div: Leonard J Ortino, chief mechanical engineer, special products div. **Henry J Kaiser Co,** Kaiser Engineers div: Colonel H George Gerdes and Edward R Lee Jr, power engineers. **John A Roebling's Sons Corp:** Charles C Shackford, product engineer, electrical wire div.

New sales managers

Westinghouse Electric Corp: Thomas R Lawson, Sunnyvale, Calif. manufacturing plant. **General Electric Co:** Daniel J McLane Jr, large steam turbine-generator dept; Christopher T Kastner and J Benning Monk, power transformer dept. **Carver Pump Co:** James E Kuppe. **Heyl & Patterson Inc:** Edward H D Gibbs. **Baldwin-Lima-Hamilton Corp:** Andrew Liston, Eddystone div.

The Garlock Packing Co: J B Sewell. **Markel Electric Products Inc:** Richard C Piper. **Fluor Corporation Ltd:** Claude M Smith, utilities. **Gustin-Bacon Manufacturing Co:** F W Muller, *Snap-On* pipe insulation sales. **Beaver Pipe Tools Inc:** Russell Herig, field sales.

The Babcock & Wilcox Co: G H Weight, Southwest district of tubular products div. **Westinghouse Electric Corp:** W Dee Shepherd, atomic power div. **The Trane Co:** Banks W Clark, Oklahoma City office. **Minneapolis-Honeywell Regulator Co,** Micro Switch div: Emmett N Hughes, Western district; John K Lincoln, Eastern district. **American District Steam Co, Inc:** Howard M Kirkby, Central zone. **Union Carbide & Carbon Corp:** C J

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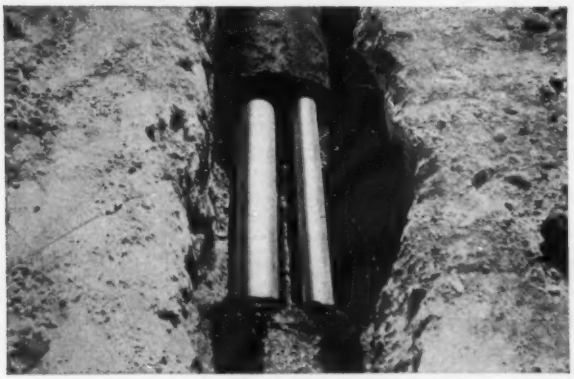

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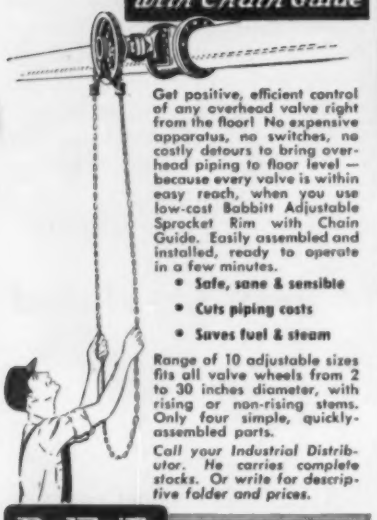

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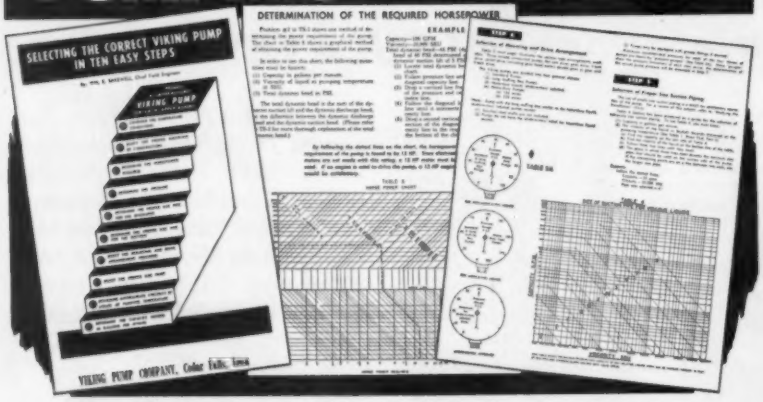
HERE'S MORE INFORMATION TO HELP YOU UNDERSTAND YOUR PUMPING PROBLEMS


SELECTING THE CORRECT VIKING PUMP IN TEN EASY STEPS
DETERMINATION OF THE REQUIRED HORSEPOWER
VIKING PUMP COMPANY, Cedar Falls, Iowa

"Selecting the Correct Viking Pump in Ten Easy Steps," is a ten-page booklet designed to help engineers in choosing the right Viking Pump for each application. This folder is free upon request.

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If you would like to have one or more copies, write today for Bulletin TS-6W.

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VIKING PUMP COMPANY
CEDAR FALLS, IOWA

More APPOINTMENTS

Begins on page 248

Chapman, industrial products for National Carbon Co. **Winsmith, Inc:** John E Sixt. **H K Porter Co,** Leschen wire rope div: L Jack Clarke. **Sterling Electric Motors, Inc:** Richard L Bedell, Rochester, N. Y. branch. **A P Green Fire Brick Co:** Charles W Glunk, Richmond, Va. branch; Dick Olson, new Baton Rouge, La. branch. **Sylvania Electric Products Inc:** Charles I Brady, New York City-Newark district. **R T Collier Corp:** Harold R Seykota. **Farris Engineering Corp:** Robert N Gierse for Farris Flexible Valve Corp.

New sales engineers

Cleaver Brooks Co: Gilbert Foster, New York boiler sales office. **International Rectifier Corp:** John D Vickrey, for selenium rectifiers. **D W Onan & Sons Inc:** Charles J Helmholtz, New England states. **Bonney Forge & Tool Works:** Robert Bader, Houston, Texas, for welding fittings div. **Femco, Inc:** Raymond G Kelley, Michigan, Minnesota and Wisconsin district; Jack Helton, W Virginia and Carolinas district. **Modern Industrial Engineering Co:** H J Crain.

Chain Belt Co: Tom Jewell, Milwaukee; Jim Collins, San Francisco; Deane Treat, Dallas; Ray Tippett, Philadelphia; Jerry Plant, Los Angeles; and Henry Kozlowski, Chicago. **Yarnall-Waring Co:** Mitchell Carson, Ray Peterson, Gordon Wagner, Chicago district. **Westinghouse Air Brake Co,** Union Switch & Signal div: L T Lincoln, West Coast area. **National Research Corp,** Naresco Equipment Corp: David Preis, northern New Jersey, New York and Fairfield County, Conn; William F Bierds Jr, southern New Jersey, central and south Atlantic states.

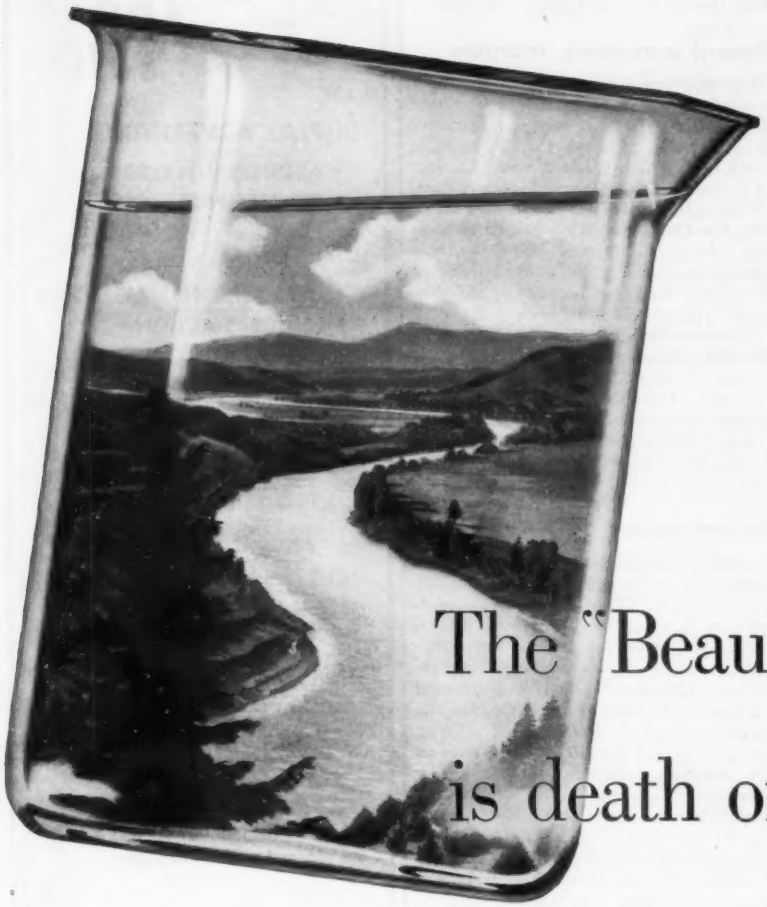
New distributors

For **General Electric Co,** carboloy dept: Dietz Industrial Supply Co, Aurora, Ill. For **American Gilsonite Co:** The Henry P Thompson Co, Cincinnati, Ohio. For **Elwell-Parker Electric Co:** Landes, Zachary & Peterson Co, Denver, Colo. For **The National Supply Co,** engine div: Harris Co, Inc, Portland, Maine; R B Richardson Co, Detroit, Mich.

New representatives

For **Electric Regulator Corp:** Gardner & Henry, Charlotte, N. C. For **The Ironton Fire Brick Co:** Foundry Service Co, 2321 29th Ave N, Birmingham, Ala. For **Powell Valves:** William Morrison, Newark, N. J. For **Murray Iron Works Co:** MacIsaac and Menke Co, pipework and boiler div, Los Angeles, Calif. For **Standard Transformer Co:** Peterson Engineering, 2000 E 7th Pl, Tulsa, Okla.

For **Dravo Corp:** William E Bailey, Chicago, handling industrial air conditioning equipment. For **Elwell-Parker Electric Co:** The Frank L Colker Co, Detroit, Mich. For **General Electric Co,** carboloy dept: Michael D Barnett, Chicago area. For **Durametallic Corp:** General Sales Inc, Amarillo, Texas. For **Electric Regulator Corp:** R L de Veer, Cambridge, Mass., New England area; Engineering



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The "Beautiful Ohio" is death on boilers

A chemical plant wanted to use Ohio river water as boiler feed. Our tests confirmed that this would result in rapid scaling and boiler tube failure . . . mineral content too high.

Graver supplied equipment which made the river water satisfactory . . . constructed the equipment, assembled it, put it in use. And we can solve your water conditioning problem, too.

Why go to Graver? Because we've been working with water treatment problems for over forty years. Graver offers you unbeatable facilities to help you get the water you need in the condition you want . . . from problem through planning to on-the-site erection.

GRAVER **Graver Water Conditioning Co.**

A Division of Graver Tank & Mfg. Co., Inc.

216 West 14th St., New York 11, N. Y.

NEW

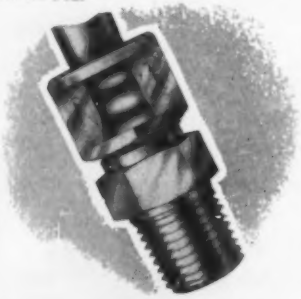
$47,000,000.00

LEAK DETECTOR

This foolproof leak-detecting device is guaranteed to locate most of your leaks very quickly. To locate leaks, you merely pipe up the plant, then check each joint for a tight seal. Most leaks will show up on this device at start-up time. Those that are not found at start-up will usually be found as soon as the plant is in operation; vibration will make it easier for you to find the leaks.

This seems like an expensive way to find leaks when you consider that the leaks could be prevented by specifying Swagelok Tube Fittings.

Leaks are expensive. Stop them before they happen. Specify Swagelok. For catalog write Department 912.



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BRASS • ALUMINUM • STEEL

STAINLESS STEEL • MONEL

CRAWFORD FITTING CO.

884 E. 140th Street

Cleveland 10, Ohio

More APPOINTMENTS

Begins on page 248

Specialties, Madeiro, Ohio. For **International Rectifier Corp:** Texport Co, Dallas, Texas. For **Chelsea Fan & Blower Co:** George C Blew, Kansas City, Mo.

Recent purchases, mergers

Minneapolis-Honeywell Regulator Co: assets of Heiland Research Corp. **Fluor Corp Ltd:** majority interest of Singmaster & Breyer Inc. **Bristol Co:** outstanding stock of American Chain & Cable Co, Inc. **H K Porter Co:** majority of common stock of Laclede-Christy Co. **Federal Pacific Electric Co:** acquisition of Gardner Electric Manufacturing Co. **A-P Controls Corp:** outstanding stock of Milwaukee Valve Co. **Simpson Electric Co:** complete plant facilities of O D Jennings & Co.

Quaker Rubber Corp and **Pioneer Rubber Mill,s** merged to form Quaker Pioneer Rubber Mills, div of H K Porter Co, Inc. **Panellit Inc** and **Taller & Cooper Inc,** affiliation to form Tal-Cooper Div of Panellit Inc. **Dorr Co** and **Oliver United Filters Inc,** incorporation of Dorr-Oliver Inc.

Recent moves

Foundry Equipment Manufacturers Assn, Inc: to No. 1 Thomas Circle, Washington 5, D.C. **The Trane Co:** Greenville, S. C. office to Shives Bldg, 644 E Stone Ave. **General Metals Corp,** Enterprise Engine & Machinery Co, a subsidiary: Chicago office to 1737 W Howard St, Room 211. **Otto H York Co, Inc:** to larger quarters at 6 Central Ave, West Orange, N. J. **Scovill Manufacturing Co:** warehouse and office to 6464 E Flotilla St, Los Angeles, Calif. **Panellit Inc:** consolidation of entire organization including Panalarm and Panascan divisions at 7401 N Hamlin Ave, Skokie, Ill. **Assembly Products Inc:** larger facilities at Line & Wilson Mills Rds, Chesterland, Ohio.

Retirements

Harold M Towne: General Electric Co, authority on lightning protection, after 45 yrs continuous service. **Dave Shore:** superintendent of Pacific Power & Light Co's Merwin hydroelectric dam and powerhouse, after 60 yrs in the electric industry. **O E Osgood:** ass't superintendent of Puget Sound Power & Light Co's White River power plant, after 44 yrs with the company.

Obituaries

Heinz W Habig, 33, president of Centrico Inc, Sept 5. **James W Condon,** 58, manager of frigidaire div, Sunset Electric Co, Aug 29. **H G Yates,** 46, senior designer of The Parsons & Marine Engineering Turbine Research and Development Assn, Sept 15. **George A Jessop,** 71, consulting engineer for S Morgan Smith Co, Sept 24.

A scholarship providing $1000 in tuition has been established at Illinois Institute of Technology by the National Association of Power Engineers.

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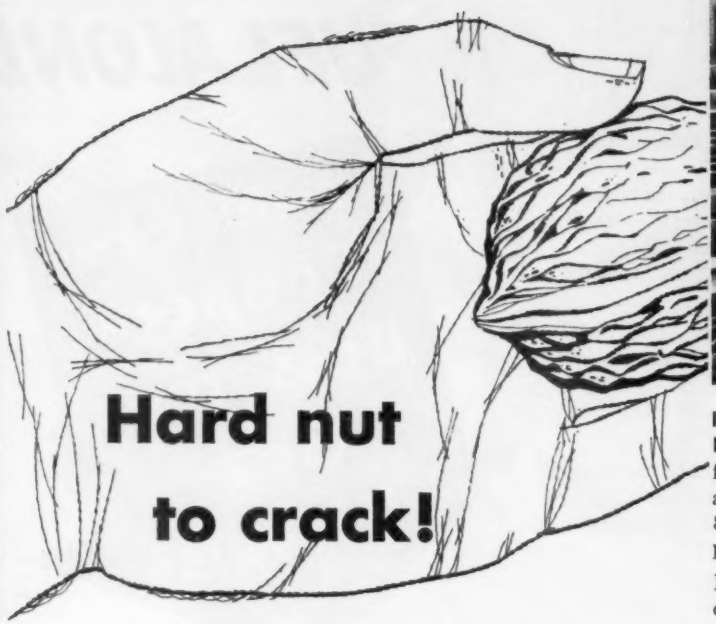
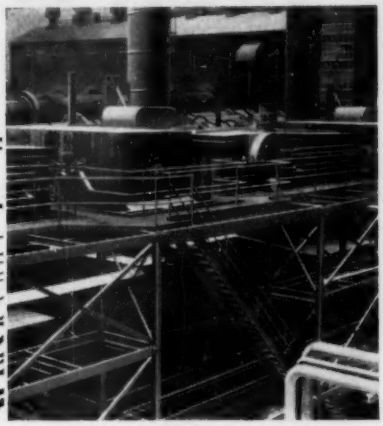


Hard nut to crack!

How to expand a plant with a minimum of interference to operations is a problem that calls for an ingenious solution. One example of Kaiser Engineers' planning foresight is its outstanding record of maintaining operating efficiency during the construction period.



Increasing Power Requirements for a major alumina producer to accompany a production increase to 800,000 tons is a job recently completed by Kaiser Engineers.

By careful scheduling and close cooperation with the operators, downtime was reduced to a matter of hours during this entire two-year job. The expansion included a steam production increase from 375,000 to 960,000 pounds per hour, used to double turbo-generator capacity to 24,000 KW and to provide additional process steam.

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• HENRY J. KAISER CONSTRUCTION CO. • HENRY J. KAISER COMPANY (Canada) LTD., MONTREAL

OGDEN SAVES $10,000 A YEAR ON FUEL ALONE!

THE engines shown below are cost-cutting Cooper-Bessemer Gas-Diesels in the extremely modern, highly efficient Municipal Electric Plant at Ogden, Iowa.

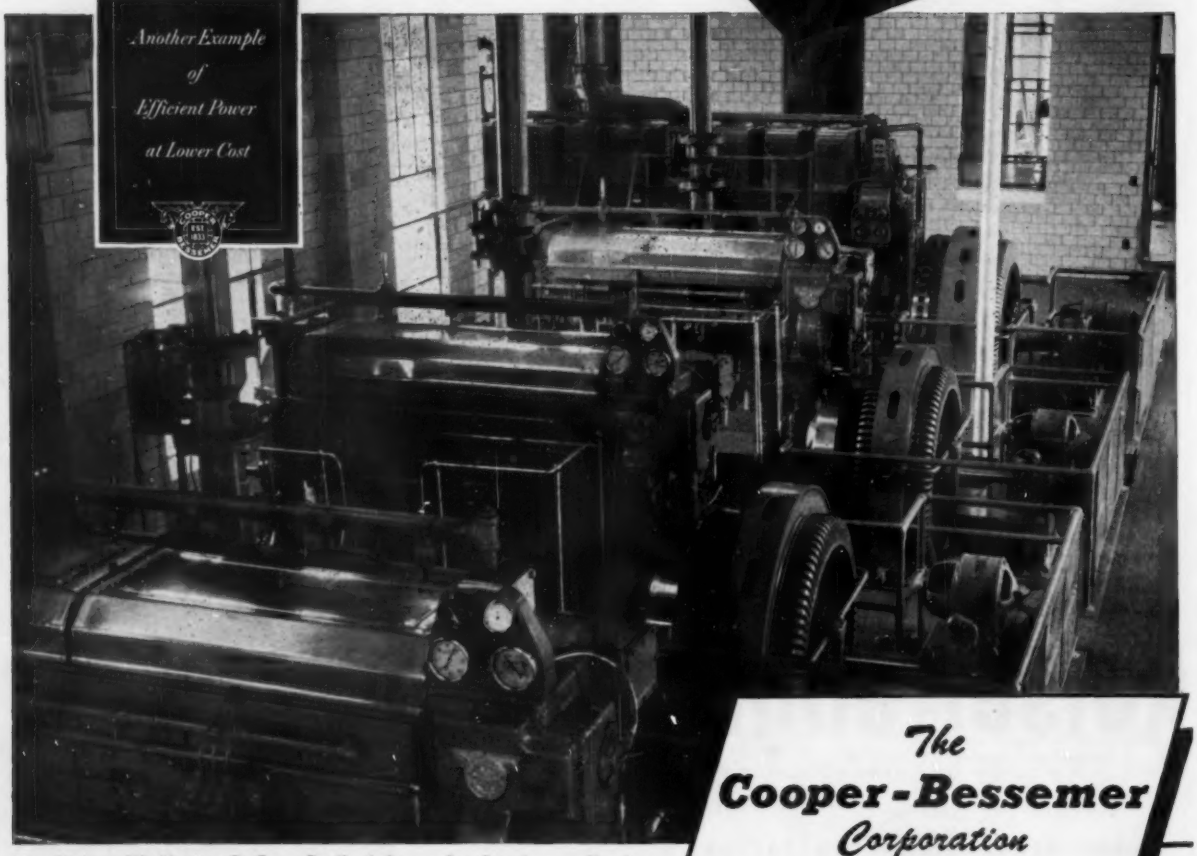
Ogden's plant was completed in 1936. It was Cooper-Bessemer-powered from the start with three of these same engines, originally oil fueled. Following Cooper-Bessemer's development of the Gas-Diesel, the engines were converted and a new JS-8 Gas-Diesel added . . . in 1951.

Today, thanks to full Gas-Diesel operation and the high efficiency of these Cooper-Bessemer engines, fuel costs are actually running over $10,000 less than they would with full oil operation.

Why not check with us on the advantages you stand to gain with Cooper-Bessemer Gas-Diesels or other new-type Cooper-Bessemers on the job?

. . . with these Cooper-Bessemer Gas-Diesels

Another Example of Efficient Power at Lower Cost



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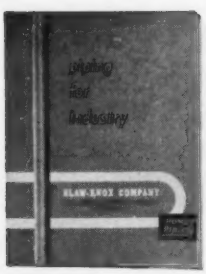
New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. New Orleans, La.

fabricated and erected by Blaw-Knox

high pressure crossover piping

. . . in large power plant



To get more information on piping for industry write for your copy of Bulletin No. 2443.

Whether you need a complicated, high pressure piping system, such as this one, or a relatively simple job, you can always turn the entire job over to us. And we'll follow through . . . in close cooperation, of course, with your consultants or your own organization.

You'll get the benefit of modern shop facilities for hot and cold bending, welding and fabricating all types of piping. A metallurgical research laboratory which assures you of the latest developments in high pressure, high temperature piping. The most modern testing equipment to assure the soundness and strength of the piping.

Plus a complete service force with modern machinery for field work and erection . . . and the necessary manpower to handle jobs of any size.

What service do you require?

We will, for instance, (1) engineer, fabricate, and erect your job . . . or (2) simply fabricate and erect . . . or (3) fabricate only.

Our engineers will quote from your drawings . . . or, when desired, make a field study of your piping requirements before quoting.

Just let us know what service you want . . . and we'll provide it.

BLAW-KNOX COMPANY
Power Piping and Sprinkler Division
Pittsburgh 33, Pa.

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POWER PIPING

Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

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For half a century we have been serving outstanding industries and institutions—thousands of engineers from coast to coast, in many foreign countries and at sea the world over choose PEROLIN. Adaptability to their maintenance problems and dependability have made our organization a leader in this field.

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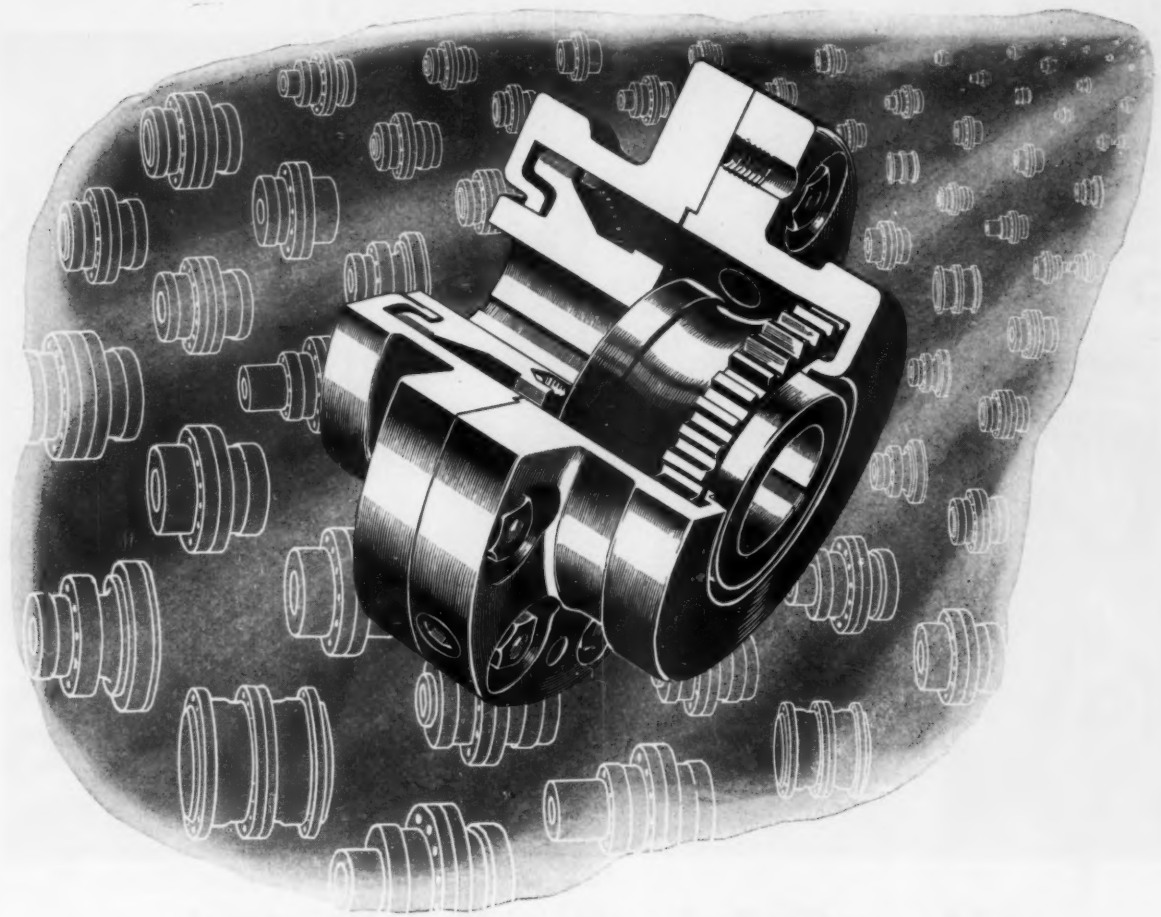

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Trouble-free performance that saves down-time, maintenance, and money led to that record. And, whatever your coupling applications, it's a guarantee of what *you* can expect from Fast's! Fast's Couplings give you *rugged construction* . . . because their original design has been maintained without basic change or sacrifice in size or materials. Fast's Couplings give you *lowest cost per year* . . . because they usually outlast the equipment they connect. And Fast's Couplings give you the benefit of Koppers *free engineering service* . . . assuring you of the right coupling for any job and the right solutions to tough coupling problems.

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FAST'S Couplings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

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Gentlemen: Send me a Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

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How to Select an Economical Temperature Regulator

First of all, what does economy mean where temperature regulators are concerned? In some industries it means improvement of product or reduction of spoilage through closer control of process temperatures. In others, it means the paring down of operating expense. The price of the regulator itself is a relatively small factor.

Today's buyers are shopping for:

1. Accuracy of control — not only when the regulator is new, but throughout its service life
2. Dependability — to prevent loss of production time
3. Minimum installation and maintenance cost

Here are a few tips on what to look for when you're installing a new or replacing an old temperature regulator —

Packless construction . . . and for this reason: A diaphragm operated, packless regulator minimizes friction. There are no closely fitted parts to stick or bind because of uneven expansion or collection of foreign matter. Also, there's less maintenance, since no repacking is ever required.

A guarantee against wire drawing of the seats and discs. Insist on it. This guarantee in combination with single seat design assures you of tight shutoff; you avoid expensive steam losses as well as loss of product in a process application.

Broad control range. In a standard regulator you should expect a control range of 100 F. And make sure the unit you select has a vapor tension thermostat that can take over-temperatures of at least 100 F.

Easy maintenance. Why ask for grief? Your temperature regulator should be basically simple in design so that it can be serviced by average plant personnel. All parts should be readily accessible for testing and cleaning.

Double duty. There's no point in buying a separate pressure regulator when you can select a temperature regulator that combines both temperature and pressure control within the same unit.

Self-operating. Make sure you get a regulator that operates on its own initial pressure. By doing so, you avoid the purchasing and maintenance of an air compressor plus air piping, and you're sure of uninterrupted operation during electric power failures.

• • • •

All of these points are important to you when it comes to selecting an economical temperature regulator. Perhaps you didn't realize you *could* expect so much. And perhaps you didn't realize that Spence Temperature Regulators offer all these features and more. May we send you our Bulletin T 500 containing further details? SE 130

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

Get this FREE Water Softener Check-up!

Find out just what kind of job your zeolite water softener is doing

Never before has such a comprehensive zeolite water softener check-up service been offered—and without charge or obligation. Regardless of the age or make of your water softener equipment, you can have a thorough, technical SECA report (Softener Efficiency Cost Analysis) prepared by an Elgin-Refinite Engineer. It will be valuable now and for future planning.

Based upon your present operation, this report will show whether you are obtaining peak efficiency from your water softener. If not—

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- More Soft Water Output
- Lower Salt Cost
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This Certified Engineering Report —
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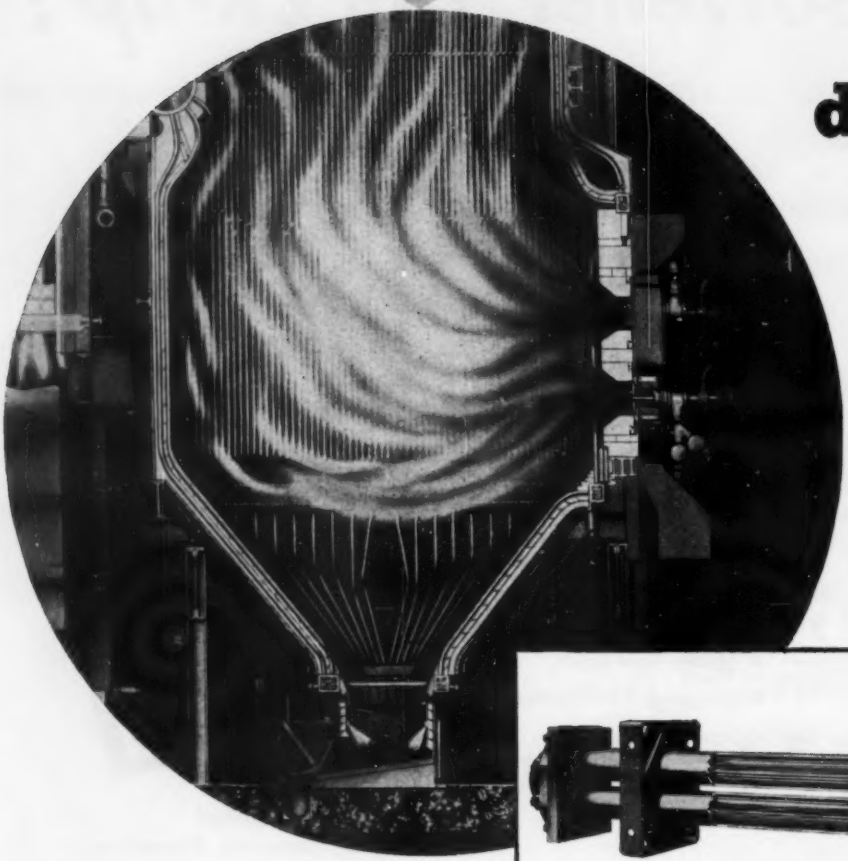

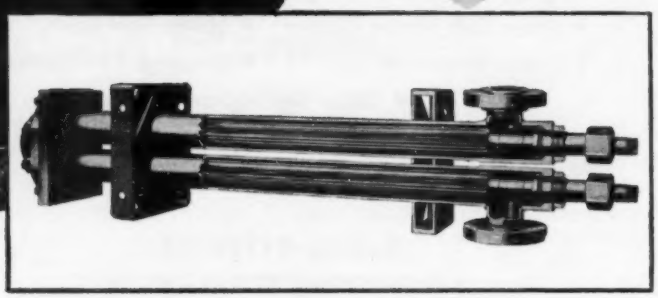

Many large-capacity high-pressure oil-burning boilers cost as much as a quarter of a million dollars; while the little fuel oil heaters that serve them cost only a few hundred dollars. But these huge boilers can deliver the desired steam only if the little heaters maintain rated capacity and preheat the fuel oil sufficiently to assure free flow.

G-R Fuel Oil Heaters will give your boilers . . . and you . . . this assurance. Their reliable ratings are based on the G-R 85 years of experience in heat transfer. Their simple design and their sturdy construction, conforming to API-ASME codes, assure dependable operation. They are easy to clean and economical to maintain.

For fuel oil heaters with these important features, investigate the G-R Line.

THE GRISCOM-RUSSELL CO. • MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS **Fuel Oil Heater**

GR-325

Fresh Water at Sea for World's Mightiest Tanker...

The two fresh water distilling plants aboard the W. Alton Jones were manufactured by Condenser Service & Engineering Company, Inc., Hoboken, New Jersey, and use Bridgeport Condenser Tubes in producing a total of 16,300 gallons a day.

Distilled with Bridgeport Condenser Tubes

The W. Alton Jones, new 38,000-ton queen of the Cities Service tanker fleet, carries an extra cargo dividend of 23,000 barrels of oil every year by distilling fresh water at sea. A single 7,000-gallon-per-day unit meets normal demand, while a second unit is used in port or to meet emergency needs.

The heart of the efficient distillation system of the ship includes Heating Bundles, Distiller Bundles, Condensate Cooler Bundles and Air Ejector After-Condensers designed and manufactured by Condenser Service and Engineering Company... all equipped with Bridgeport 70-30 Cupro Nickel Condenser Tubes.

To find out how this alloy or other of Bridgeport's wide variety of Tube Alloys can improve your operating economy, call your nearest Bridgeport Sales Office. They will welcome the opportunity to discuss your requirements and also tell you about Bridgeport's Technical Service.

Are you receiving our monthly Copper Alloy Bulletin regularly? We'd like to add your name to our mailing list, to get news of the latest developments in the Condenser Tube field and useful design and maintenance information.

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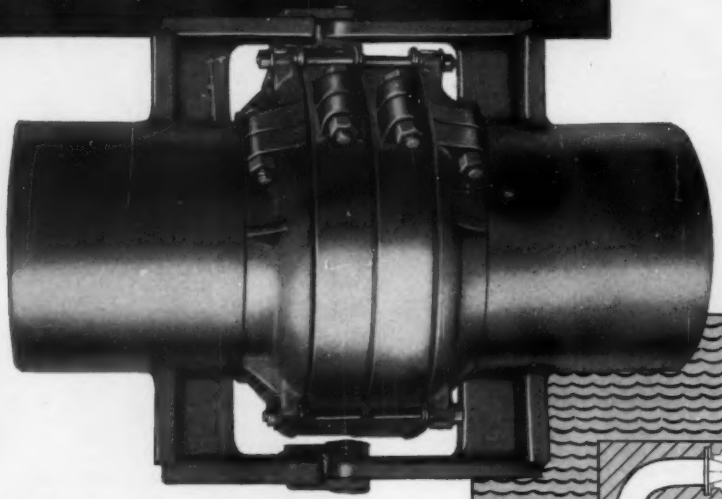
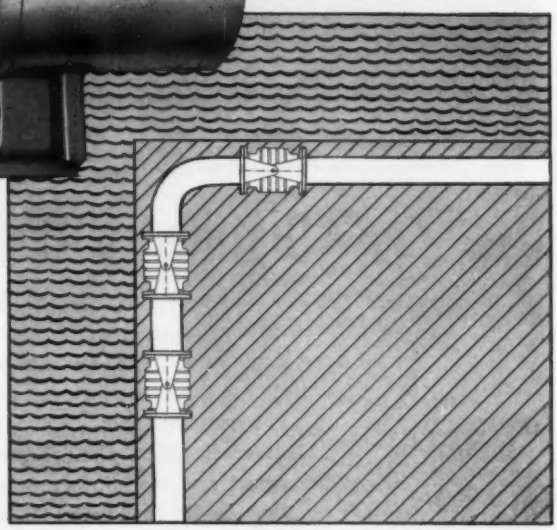
BADGER

EXPANSION JOINTS

Typifying Joint Engineering at its Best

THE *Hinged* EXPANSION JOINT





- **Absorbs Angular Rotation caused by Pipe Displacements**
- **Permits Line Installation without Intermediate Anchors and Guides**

The sketch shows a typical use of Badger Hinged Expansion Joints... not merely a hypothetical case but one of many instances where Hinged Joints serve as outlined above.

The problem was to run a steam line along two sides of a waterfront pier. However, since the pier structure was not strong enough to permit proper anchoring of the elbow in the pipe line, the standard type of joint could not be used. With these Badger Hinged Joints, it was possible to absorb the large amounts of thermal expansion in the pipe line without the need for an intermediate anchor.

Hinged Joints must always be used in groups of two or more. Three such joints give a maximum of flexibility while reducing to a minimum the thrust on the end anchors.

The Hinged Joint is but one of several special Badger Expansion Joints designed for unusual conditions. Why not outline *your* proposed pipe line installations to our engineering department? We can serve you whether special or conventional type expansion joints are needed. And back of our service is some sixty years of experience.

Badger Expansion Joints come in a variety of types and a wide range of sizes: Directed Flexing, Self-Equalizing for longer traverses and higher pressure; Non-Equalizing, for shorter traverse and when pressures are low; Tandem Joints for combination axial and lateral movements; Clevis or Hinged Joints for angular rotation.

Corrugated Flexible Connectors; Flexible Pipe Line Seals for watertight connection between pipe and flood walls.

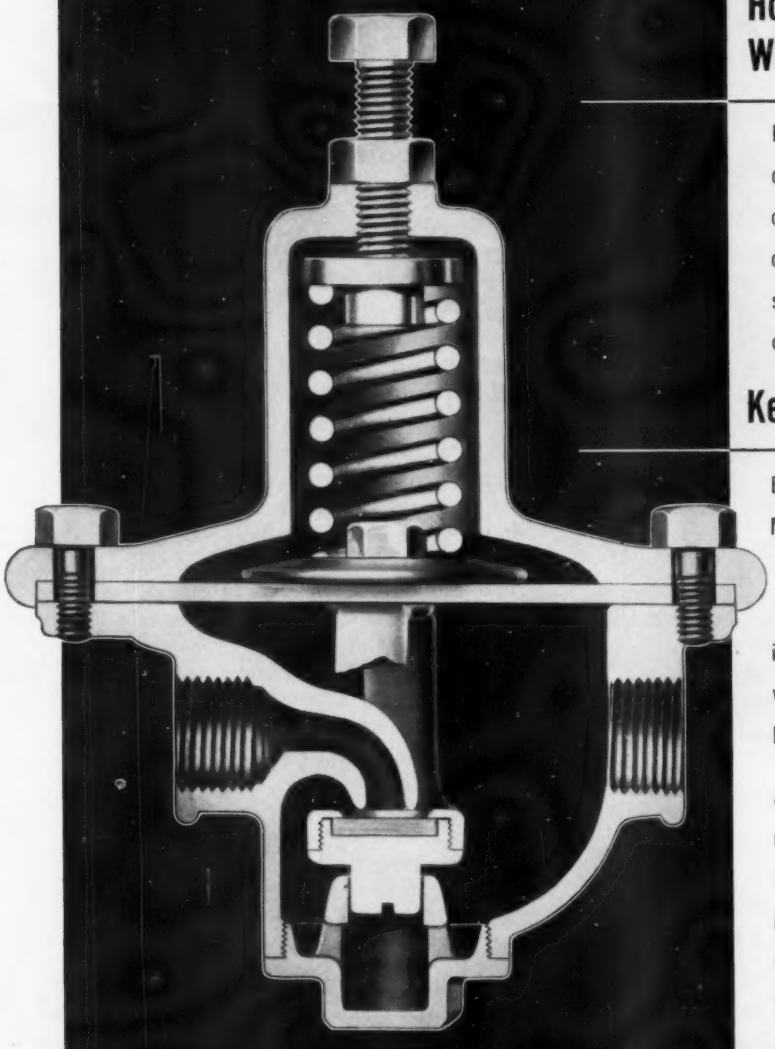
BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE 41, MASS.

MASONEILAN No. 227

FOR WATER



Holds Pressures Constant Without Cutting Flow

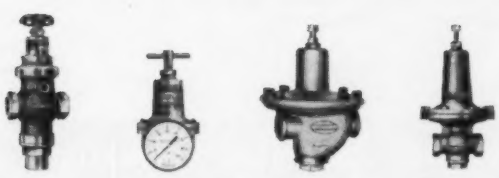
Here's a reliable reducing valve that holds domestic or industrial water pressures constant. Stops vibration — reduces strain on plumbing. Eliminates "singing" and splashing from fixtures — without cutting down on flow.

Keeps Costs Down

Built to exceptionally rugged standards, a Masoneilan No. 227 requires little or no maintenance. The heavy-duty fabric reinforced rubber diaphragm lasts indefinitely. Renewable composition disc valve insures tight shutoff. Sturdy bronze body resists corrosion.

Available for initial pressures up to 150 lbs., reduced to pressures between 10 and 100 lbs. Sizes from ¼" to 2". For more information, write Mason-Neilan Regulator Company, 1186 Adams Street, Boston 24, Mass. . . . or see your local Industrial Distributor.

ALL HIGH Quality Coefficient PRODUCTS



No. 11 for steam No. 71 for air No. 227 for water No. 33 for steam

MASONEILAN REGULATORS

Keep Pressure Under Control!

No other instrument

for recording pH or conductivity

offers this cost-saving combination

1. Six-point recording on a single round chart

2. Freedom from slidewire limitations

HERE'S THE IDEAL MEANS of recording pH and conductivity in boiler water, condensate, make-up water and circulating water. The Foxboro Multi-Record Dynalog* can measure and record up to 6 points on conductivity . . . or 6 points on pH (with only 1 pre-amplifier). It uses convenient circular charts . . . easy-to-read, economical-to-use. A substantial saving in initial cost of instruments is also assured.

IN ADDITION, Dynalog Instruments have *no slidewire,* no contacts to stick, wear or corrode. Maintenance is practically eliminated. Because of their completely electronic design, these instruments offer new standards of sensitivity, speed and accuracy . . . proven process improvers, cost-savers and trouble-savers. Here's your opportunity to step up plant operating efficiency. Write for detailed Bulletin 430-1. **The Foxboro Company, 6811 Neponset Ave., Foxboro, Mass., U. S. A.**

*Reg. U. S. Pat. Off.

Here is the unique, simple rotary-capacitor balancing device of Dynalog Instruments. Its sensitivity is not limited by turn-to-turn winding of slidewire. Balancing is completely STEPLESS as well as continuous. It requires no high speed motor, no galvanometer. Advanced electronic design also eliminates dry cell batteries . . . no standardizing. The simplest potentiometer ever built!

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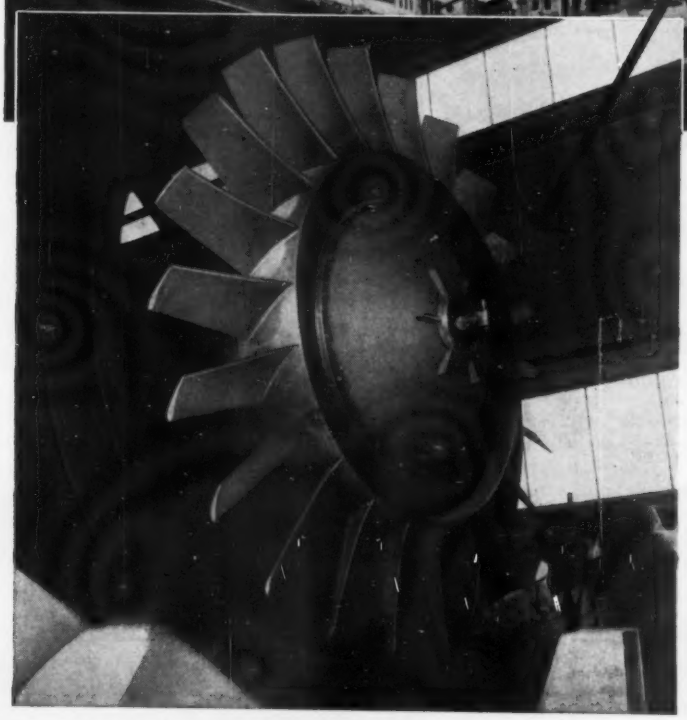
An epoch-making feature in designing of Mechanical Draft Fans.

Highest Efficiency in VOLUME CONTROL



Write for the VARIAX catalogue.

The VARIAX

Variable Axial Flow Fan for Forced and Induced Draft etc.

- blades adjustable at full speed operation.
- maximum efficiency 94%.
- moderate sound level.
- resistant to wear from impurities in gasflow.

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Factory and Head Office:
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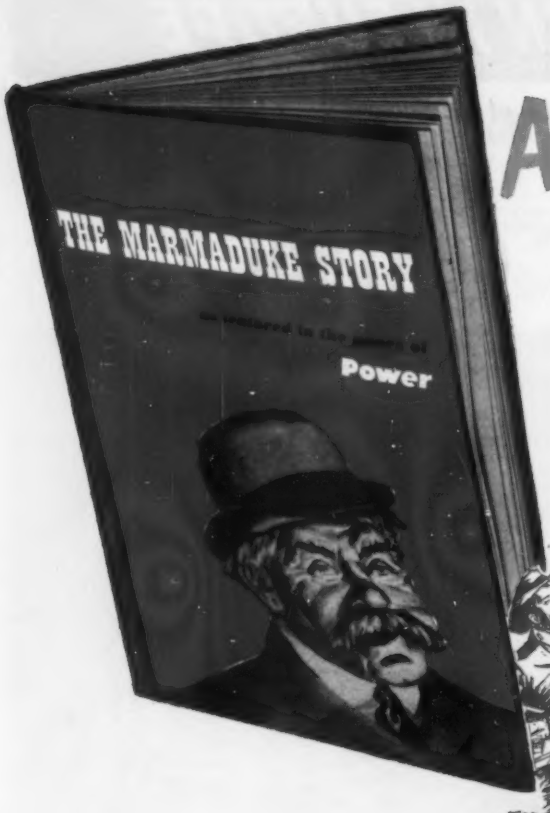
NORDISK VENTILATOR CO



A SHIP LOAD of wonderful Marmaduke stories

. . . and only $1.

Here are *twenty-one* of Marmy's most fabulous exploits, exactly as told in the pages of POWER.

Here is the cantankerous old sea dog turned into a consulting engineer, whose ingenuity is amazing but always possible and even plausible.

As POWER readers well know, Marmy's office is upstairs over O'Houlihan's Machine Shop & Engine Works, where the phone number is Hell's Kitchen 2-1876. But his principal hangout is in The Bent Propeller Bar, whose proprietor's name is Bedlam, and where you're likely to find Marmaduke meditating over a bottle of Sandpaper Gin.

We have good reason to think that Marmaduke Surfaceblow is about the best known character in the power field—maybe in all industrial journalism. Here are the stories that made him so, handsomely bound in a colorful varnished cover, only one dollar. Supply is limited. Order today.

POWER, READER SERVICE DEPT.
330 West 42nd St.
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Enclosed find_____for which please send postpaid_____copies of "The Marmaduke Story" at $1. per copy.

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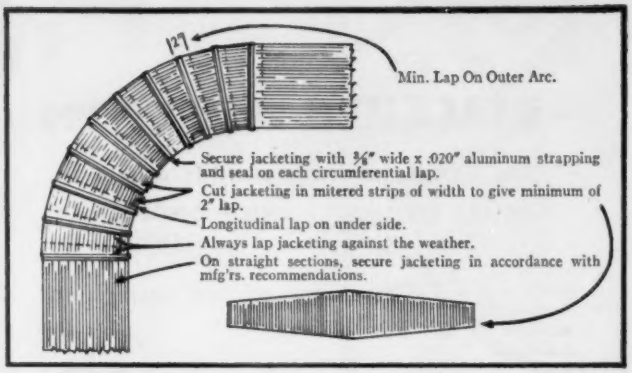

Min. Lap On Outer Arc.
Secure jacketing with ¾" wide x .020" aluminum strapping and seal on each circumferential lap.
Cut jacketing in mitered strips of width to give minimum of 2" lap.
Longitudinal lap on under side.
Always lap jacketing against the weather.
On straight sections, secure jacketing in accordance with mfg'rs. recommendations.

New method of applying aluminum jacketing over pipe bends with a radius of 5 diameters or more is shown above.

Cutaway view shows how jacketing goes on right over the insulation. Tests show Childers is the lowest cost of any permanent metal jacketing that is available today.

Only pliers and pocket knife needed to apply easy-to-handle Childers Aluminum Jacketing

Best method of applying jacketing is with aluminum strapping and seals. Other method is to use sheet metal screws.

Aluminum strapping can be pulled tight enough with just pliers. Lugs are then bent over and fastening is complete.

Eastern States Petroleum's two-man crew covers insulated lines, even L's and bends—using light-weight, weatherproof aluminum jacket.

Childers Jacketing for insulated lines, made of .006" 3S alloy aluminum, was used to cover thousands of feet of line in Eastern States Petroleum's Houston plant.

As it does in over 1000 other plants in all 48 states and many foreign countries, Childers Jacketing helped save Eastern States many expensive hours of application and maintenance time.

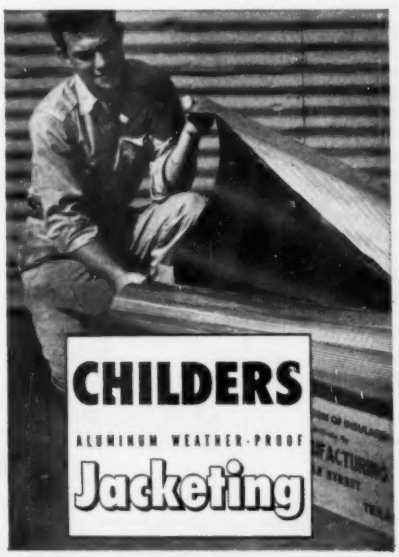
In fact, tests show this: Two men, working with Childers Jacketing for the first time, can cover more feet of insulated line in a day than with practically any other kind of covering. This means real savings in application costs.

The cost is low, too. You can actually put aluminum jacketing on your lines for less than the cost of the cheapest weatherproofing when one paint job is considered.

Immediate shipment from our large factory stocks can eliminate costly delays in construction or plant improvement schedules.

Try this low cost protection in your plant. Write today for engineering data and information about how you can order a 400 sq. ft. roll to test on one of your insulated lines. No obligation. Address: Childers Manufacturing Company, Department PO-9, 3620 West 11th Street, Houston, Texas.

Engineering representatives in most cities to work with you on jacketing problems.



Childers Jacketing arrives on the job in convenient rolls 4 feet wide and 100 feet long—easy for one man to handle. Jacketing comes with or without a moisture barrier attached to the back of the .006" aluminum. Rolls are well protected for field storage if kept dry. Boxes light enough for one man to carry. (Adv.)

BLACKMER ROTARY PUMPS

ARE HANDLING THESE LIQUIDS AND SEMI-SOLIDS EFFICIENTLY AND ECONOMICALLY

Acids
Acetates
Alcohols
Ammonia
Beer
Bilge Water
Black Liquor
Bleaches
Brewery Slop
Brines
Catsup
Caustics
Coal Tar
Cream Corn
Creosote
Dog Food
Dyes
Enamels
Fish Juices
Fuel Oils
Gasoline
Glucose
Glue
Glycerine
Grape Juice
Kerosene
Lacquers
Lard (hot)
Mash
Mayonnaise
Milk
Mineral Oil
Molasses
Oils —
- Cooking
- Crude
- Lube
- Palm
- Vegetable

Naptha
Paints
Paraffin
Printing Ink
Rubber Cement
Salad Dressing
Shellac
Silicate of Soda
Sizings
Soaps
Solvents
Soups
Starches
Syrups
Tan Liquor
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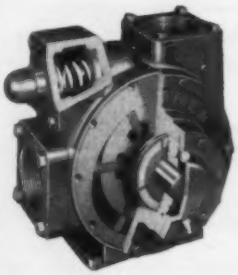
Tar
Tomatoes
Turpentine
Varnishes
Vinegar
Wine
Yeast

CHECK THESE FEATURES AGAINST YOUR PUMP REQUIREMENTS



Sliding or swinging vanes are self-adjusting for wear and easily replaced.

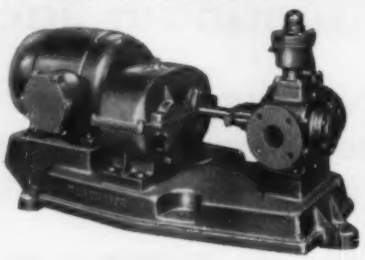
Liner replacement renews pump.

Mechanical shaft seal or chevron packing available.

Capacities from 5 to 1500 G.P.M.

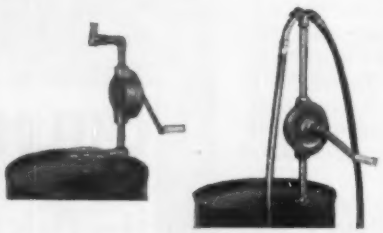
CUT MAINTENANCE AND REPLACEMENT COSTS ... ELIMINATE OUT OF SERVICE DELAYS!

Twenty years of continual service is not unusual for a Blackmer Pump. When it is necessary to replace the liner or vanes, any mechanic can do so in a matter of minutes.



IN HAND PUMPS AS IN POWER PUMPS ... BLACKMER PERFORMANCE SPEEDS LIQUID MATERIALS HANDLING

Self-priming with high suction lift. Blackmer Hand Pumps are ideally suited for plant use where spilling of liquids may prove dangerous as well as wasteful. Available in capacities from 7 to 28 G.P.M.



liquid materials handling®

BLACKMER

Industrial, Hand and Truck Pumps, Strainers, Pressure Control Valves

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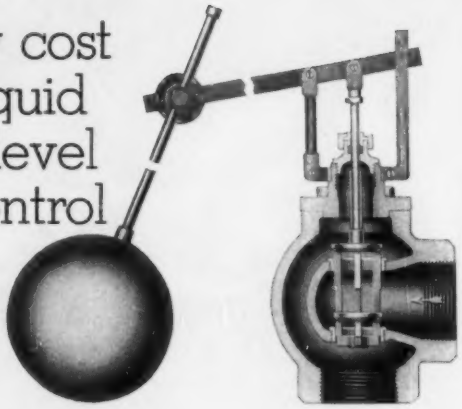
low cost liquid level control



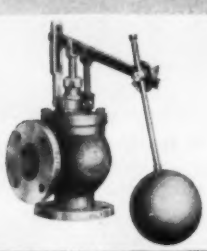
Klipfel FLOAT VALVES

On the majority of liquid level control applications, there's no need for fancy electric-electronic set-ups. A simple float valve, correctly engineered for the particular service, does the job just as well, at lowest cost.

Klipfel Float Valves assure dependable, trouble-free service with a minimum of maintenance.

Write today for your copy of Klipfel Bulletin 349. It gives helpful type and size selection data and complete description of the wide range of Klipfel types, styles and sizes for every service.

- **Float and Lever types**
- **Single and Double-Seated**
- **Direct and Pilot Controlled**
- **Sizes from ½" to 12"**
- **Temperatures to 450°**



KLIPFEL NO. 77 PILOT CONTROLLED FLOAT VALVE

For Quick Service

Call your supply house or Klipfel Distributor listed in yellow pages.

Klipfel VALVES, INC.
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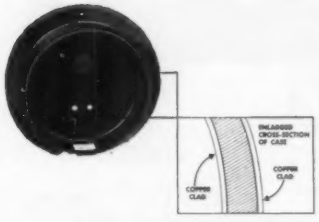
You're looking at the biggest pressure gauge development since the "Recalibrator"



Another first for Marsh

Here is a case in keeping with the "Conoweld" tube. Another recent Marsh development, it is called the

New *Marshalloy* Case

It is a copper-clad wrought steel case of boiler plate thickness, four times as strong, and one-third lighter than conventional cast iron cases. Copper surface makes it as non-corrosive as a plastic or die-cast case. Handsome, corrosion-resistant, satin black enamel and Marsh safety blow-out plug are the finishing touches.

Here is one of those typically MARSH developments . . . the kind of pioneering step you have come to expect from the organization that originated the basic advances in pressure gauges culminating in the exclusive "Recalibrator." This latest Marsh development is known as the

NEW MARSH *"Conoweld"* TUBE

This time we have made the best part of the best Marsh gauge still better. We have gone into the part that actually does the work — the socket and tube — and have made it permanently leak-tight from inlet to tip of tube.

We have done this by fusing the tube into the socket and the tip to the tube so that the whole assembly is truly *one piece.* The photo of one of the sockets sawed in half shows the perfect fusion of the vital joint. Tests and photomicrographs prove the perfection of the fusion.

Developing the fusing process called for extensive research. The method as finally perfected — the "Conoweld" process — involves first fusing the tube to the socket and end-piece; then tempering the tube to required resiliency.

Yes, it is these dramatic departures from beaten paths that have achieved leadership for Marsh gauges and are ever increasing that leadership. Ask for latest information covering gauges for all services.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
Dept. F, Skokie, Ill. *Export Dept., 3501 Howard St., Skokie, Ill.*

MARSH GAUGES

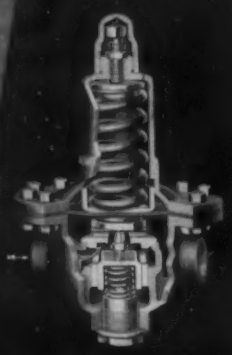
"THE STANDARD OF ACCURACY"

MANUFACTURERS OF THERMOMETERS • WATER REGULATING VALVES • SOLENOID VALVES • HEATING SPECIALTIES

If it's...

McALEAR equipped

it's under **SAFE** control



One of the many McAlear Controls—No. 258 Pressure Reducing Valve compactly designed for service requiring a tight shut-off and is in widespread use for controlling air, gas and steam pressures.

There's one thing you can be sure of in McAlear Controls and that's dependability... for infinite care and engineering exactness guard every step of McAlear manufacturing. And before a McAlear control is shipped for sale or use it is job tested for performance. That's why we say—"If it's McAlear Equipped it's under SAFE control." Write for descriptive literature today.

FOR EVERY CONTROL NEED REMEMBER McALEAR

McALEAR controls

PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE

for STEAM, WATER, AIR, OIL, GAS

McALEAR MANUFACTURING COMPANY

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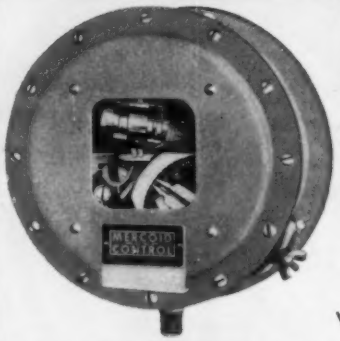
MERCOID®

PRESSURE CONTROLS

FOR OUTDOOR SERVICE



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Moisture Resistant
Rain Tight
Water Tight

Equipped with Sealed Mercury Contacts

External Adjustments

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AVAILABLE IN 17 PRESSURE RANGES FROM

0-30" VAC. TO 300-2500 PSI.

WITH THE SENSITIVITY YOUR APPLICATION REQUIRES

Mercoid weather resistant controls are also available for temperature and liquid level applications.

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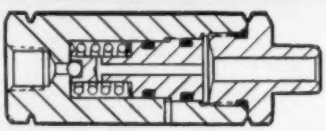
VALVES

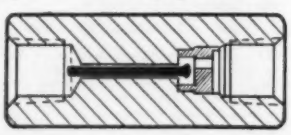
INDUSTRIAL · CHEMICAL · AIRCRAFT



REPUBLIC GAGE PROTECTOR

PROTECT your expensive gages from severe pressure fluctuations and shock with Republic gage protectors and snubbers. Designed for a wide range of settings and service conditions. Standard units are brass, with pipe thread connections as shown. Other materials and connections are available on special order. Gage protectors fit standard gage connections, 15 to 5,000 psi.

REPUBLIC PRESSURE GAGE SNUBBER



Write for complete catalog and nearest distributor.

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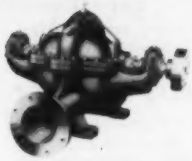
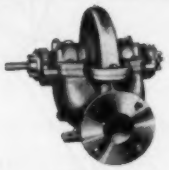
**TIME \ MONEY \ ENERGY **

TYPE PE FLUIDYNE INTEGRAL HP PUMPS
A complete line of electric close-coupled general purpose pumps. Threaded or flanged connections. Capacities: to 800 gpm; heads: up to 260 feet; motors: up to 50 h.p.

TYPE PB FLUIDYNE CENERAL PURPOSE PUMPS
Flexible coupled, single-stage, end suction, general purpose pumps. Rugged and durable. Capacities: up to 5500 gpm; heads: up to 260 feet; motor: up to 150 h.p.



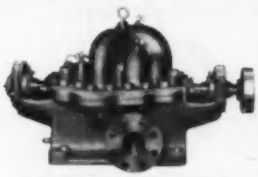
TYPE A GENERAL PURPOSE PUMPS
For application to the widest variety of pumping conditions. Single stage split case design. Capacities: up to 70,000 gpm; heads: to 300 feet. All types of drive.



TYPE AS GENERAL PURPOSE PUMP
The centrifugal pump with mechanical shaft seals that eliminate the packing box. Up to 4" in discharge sizes. Capacities: up to 750 gpm; heads: up to 210 feet.

BY BUYING FROM THE COMPLETE LINE

VERTICAL DEEP WELL TURBINE PUMPS
For application to deep well pumping. Lifts from 1000 feet or more. Capacities: up to 30,000 gpm. H.P. range: up to 1000 h.p. oil and water lubricated types. Widest range of sizes.



TYPE TU BOILER FEED AND PROCESS PUMP
2-stage high pressure pump for water and other liquids. Capacity: 50 to 3500 gpm; heads: up to 600 feet. Internal cross over is built into top half of pump case.

TYPE TUT MULTI-STAGE PUMPS
3, 4 and 5-stage pumps for water handling and process services. 1" to 5" discharge sizes. Capacity: up to 1350 gpm; head range: up to 1600 feet. Split case design.

INDUSTRIAL SERVICE PUMPS
For application to pits, sumps, basins, reservoirs and other surface water sources. Same capacity as deep well turbine above. H.P. range: up to 2500 h.p.

HYDRO-LINE PUMPS
An enclosed, close-coupled, vertical centrifugal process pump for handling petroleum hydrocarbons, where NPSH is limited. Capacities: to 6000 gpm; heads: to 1500 feet.

HI-LIFT PUMPS
The unique positive displacement deep well pump that literally squeezes water upward. Capacity: 10 to 55 gpm; lifts: up to 1000 feet. For wells 4" in diam. and up.

PEERLESS PUMP

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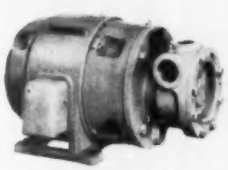
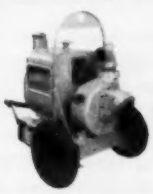


TYPE TVE & TVB TURBINE VANE PUMPS
Standard and self-priming, close-coupled and flexible-coupled pumps for hot and cold, clear and vaporous liquids. Capacities: up to 58 gpm; heads: up to 800 feet.



SELF-PRIMING PUMPS
Rugged, compact, portabe self-priming pumps manufactured to AGC specifications, seven models and types to choose from providing 4,000 to 30,000 gallons per hour.

FOR ALL YOUR PUMPS FOR ALL YOUR NEEDS—LOOK TO PEERLESS FOR:

THE COMPLETE LINE—
THE QUALITY LINE—
THE DEPENDABLE LINE—
THE ECONOMICAL LINE—
THE TIME-SAVING LINE!

PEERLESS PUMP

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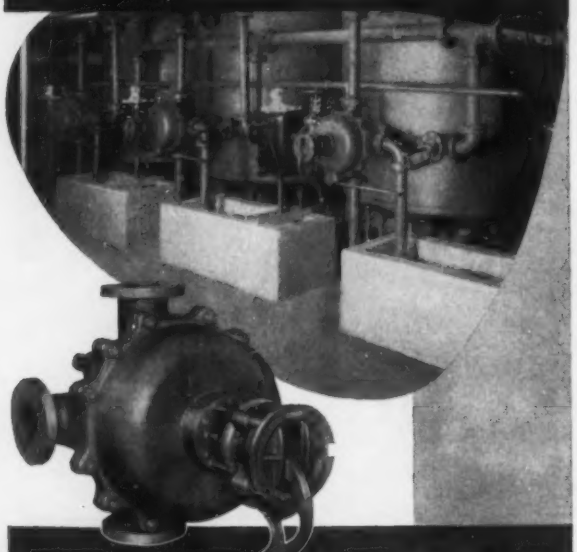
Solo Valves...
INDUSTRY'S STANDARD FOR YEARS



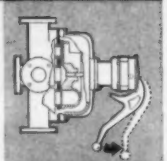
SPECIFY *AquaMatic*
LIFT-TURN SOLO VALVES for
Longer, Leakproof SERVICE

Rubber Seated Multi-Port Valves for Water Softeners, Pressure Filters and Ion Exchangers

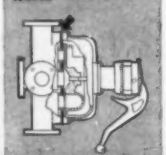
AquaMatic Solo Valves pressure-seat on long-wearing, resilient rubber . . . no metal-to-metal contact . . . no leakage from port to port. Lift-turn principle eliminates sticking, scoring, and wear . . . insures long valve life. With single lever control, Solo valve cannot be turned until lifted from seat. One multi-port Solo valve handles a complete regeneration cycle . . . built-in ejector and backwash controls are part of the valve.

All pipe connections are made in back-plate member . . . Solo valve can be dismantled, inspected, and serviced without removing pipe.

Tens of thousands of installations have proved the durability and reliability of AquaMatic Solo Valves. Investigate them TODAY.



HANDLE MUST BE RAISED TO INDEX SOLO VALVE—ELIMINATES . . . SCORING, STICKING, WEAR



VALVE SEATS ON SOFT RESILIENT RUBBER FOR LEAK-PROOF CLOSURE

AquaMatic and Solo Valves are trade-marks of AquaMatic, Inc., Rockford, Illinois

AVAILABLE IN 3/4 TO 4-INCH SIZES

Write for FREE Catalogs

ENGINEERED WATER *AquaMatic* TREATING SPECIALISTS

AquaMatic INC. *Formerly Automatic Pump & Softener Corp.*
ROCKFORD • ILLINOIS

there is no "TOP"

for power plant experience!

CASH IN on your practical, mechanical knowledge. Dearborn will train you as a

SALES ENGINEER

Established territories now open.

If you are 30 or older . . . have several years of boiler room experience . . . we will train you as a Dearborn Sales Engineer. Salary, commission, expenses, profit-sharing, group insurance, pension plan, paid vacations and sickness benefits.

If you are interested in learning more, why not come in and talk it over? Write or phone for a confidential interview.

Dearborn
TRADE MARK

DEARBORN CHEMICAL COMPANY, Merchandise Mart Plaza, Chicago 54, Ill.
Phone: WHitehall 4-3273

POWER's special report to executives is coming in December

"New Profit OPPORTUNITIES *in the* Power Services"

It will show how sound power service management throughout American industry can save one cent in four *adding ten percent to net!*

If you would like to have a copy of this report sent free to an executive in your firm, see pages 202-203 in this issue.

What's your angle?

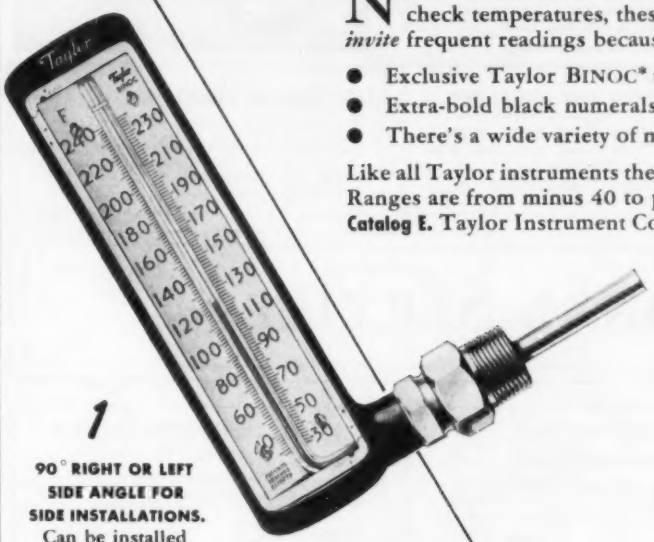
NO MATTER how awkward the angle from which your operators have to check temperatures, these easy-reading Taylor Industrial Thermometers *invite* frequent readings because—

- Exclusive Taylor BINOC* tube is three times easier to read.
- Extra-bold black numerals stand out sharply on white background.
- There's a wide variety of mounting angles, stems and connections.

Like all Taylor instruments they're built to give you years of dependable service. Ranges are from minus 40 to plus 950° F. or equivalent Centigrade. Write for **Catalog E.** Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

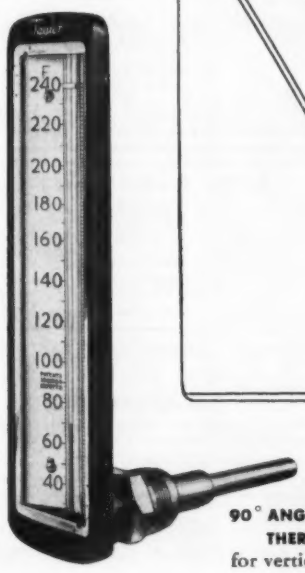
*Reg. U.S. Pat. Off.

Taylor Instruments
MEAN ACCURACY FIRST



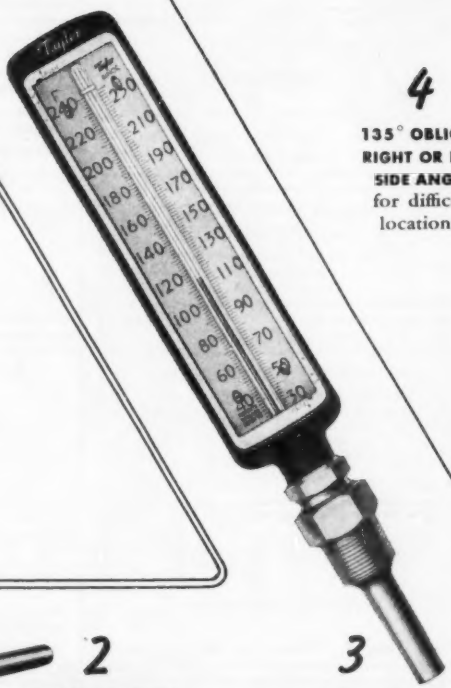
1

90° RIGHT OR LEFT SIDE ANGLE FOR SIDE INSTALLATIONS.
Can be installed forward or backward for eye level reading.



2

90° ANGLE INDUSTRIAL THERMOMETER
for vertical pipe lines.

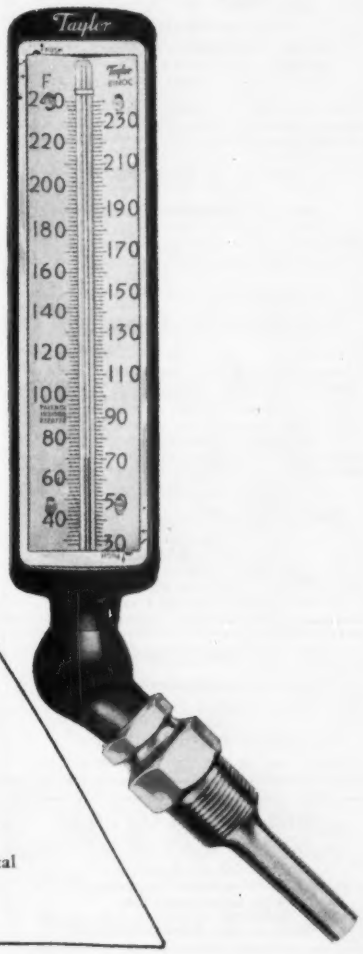


3

STRAIGHT INDUSTRIAL THERMOMETER
for inserting on horizontal pipe lines.

4

135° OBLIQUE RIGHT OR LEFT SIDE ANGLE
for difficult locations.



WHERE TO BUY

Featuring additional products specialties and services for power plants

HILL PUMP VALVES

Since 1909

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

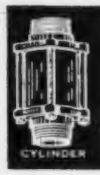
Write for Bulletin

HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

STOP *that* WATER

With FORMULA No. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. $3 in 55's. Free sample. See Sweet's.

HAYNES PRODUCTS CO., OMAHA 3, NEBR.



FLOW INDICATORS
All sizes up to 6"
SEND FOR CATALOG
ERNST
Water Column & Gage Co.
LIVINGSTON, N. J.

Purchasing Men Say—
MIDCONTINENT TUBE SERVICE, INC.
does best job in country furnishing—
CARBON & ALLOY STEEL PIPE & TUBING.
Specialists in hard-to-find specs and sizes.
Write For Stock List
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. Davis 8-4030

A Good Habit

This Where To Buy Section supplements other advertising in this issue with additional announcements of products and materials of special interest and application in the power generation and transmission field. Make a habit of checking this page each issue.

PROFESSIONAL SERVICES

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
Investigations, Valuation and Rates
4706 Broadway — Kansas City 12, Missouri

LUTZ AND MAY
Consulting Engineers
STEAM, GAS & DIESEL POWER STATIONS
PUMPING PLANTS—ELECTRIC SYSTEMS
REPORTS—DESIGN—APPRAISALS
1009 Baltimore — Kansas City 6, Mo.

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
David Moffat Myers, Consultant
Mechanical — Electrical — Civil
Surveys Reports Design
101 Park Avenue — New York 17, N. Y.

BURNS & McDONNELL
Consulting and Designing Engineers
Kansas City, Mo. — P. O. Box 7088
Cleveland Ohio — 1404 E. 9th St.

FRED L. PEARSON and ASSOCIATES
Consulting Engineers
1231-38 Majestic Bldg. — Detroit 26, Mich.
Woodward 5-0188

J. E. SIRRINE COMPANY
Engineers
Power Plants — Consultations
Design — Reports
Water — Steam Utilization — Plants
Greenville — South Carolina

GILBERT ASSOCIATES, INC.
Engineers • Consultants • Constructors
Engineering and Design • Construction Supervision
Industrial • Sanitary • Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing
607 Washington St., Reading, Pa.
New York • Philadelphia • Washington

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. — Chicago 4

STANLEY ENGINEERING COMPANY
Consulting Engineers
Power Plants
Steam — Diesel — Hydro
Design — Construction — Test — Valuation
Hershey Building — Muscatine, Ia.

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

PIPING DESIGN DIVISION
MARQUETTE COPPERSMITHING CO.
Piping Flexibility—Structural Components
Vibrations—Scale Model Tests
Analyses—Reports—Field Service
Ask for Bulletin PDD-4
(Est. 1888)
P.O. Box 4548 — Philadelphia 31, Pa.

SYSKA & HENNESSY, INC.
Engineers
Consultation — Plans — Reports
Power Plants — Disposal Plants
Water Systems
114 East 39th Street
New York, New York

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
Power Plant
Specialists
Utility — Industrial — Chemical
1200 N. Broad St. — Philadelphia 21, Pa

SANDERSON & PORTER
Engineers and Constructors
New York • Chicago • San Francisco

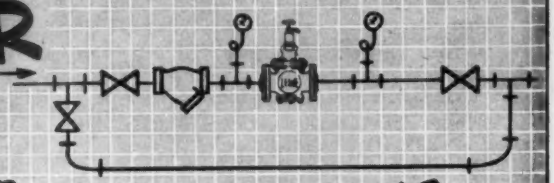
WATER SERVICE LABORATORIES, INC.
Specializing Since 1927
Water Treatment for corrosion control in buildings, boilers and air conditioning systems.
New York—Philadelphia—Washington, D. C.

PETER F. LOFTUS CORPORATION
Engineering and Architectural Consultants and Designers
First National Bank Bldg.
Pittsburgh 22, Pennsylvania
Cable Address—"LOFTUS Pittsburgh"

SARGENT & LUNDY
Engineers
140 South Dearborn St. — Chicago, Illinois

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

WHEN TO USE A REGULATOR



SELF-CONTAINED PRESSURE, TEMPERATURE AND PUMP PRESSURE REGULATORS

Leslie Self-Contained Regulators are spring loaded, internal pilot, piston or diaphragm operated with stellited seating surfaces, hardened stainless steel main valves and renewable wearing parts of heat treated stainless steel of grades best suited to the application.

Regulators are used for any one or any combination of the following conditions:

★ When quick response is necessary to handle sudden load changes.

★ When available fluid pressure supplies sufficient differential for self operation.

★ When positive dead end shutoff is required for short periods of time.

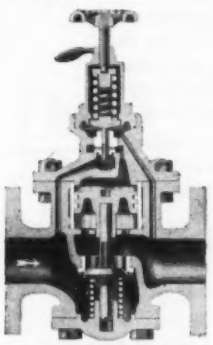
★ When one-step pressure reductions are desired.

★ When service conditions require continuous flow for varying demand.

★ When "instrument control" is required without auxiliary operating force.

★ When installation requires smallest physical dimensions.

★ When operation from either a nearby or a remote control station is desired.

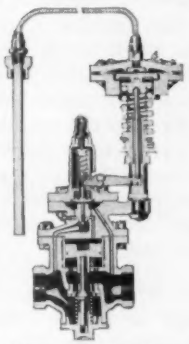


Pressure Reducing Valve
Class L-3

LESLIE
PRESSURE REDUCING VALVES

Automatically maintain a constant reduced pressure of steam, air or gas. Single seated, tight closing. Respond instantly to load changes. Renewable, interchangeable parts. Stellited seating surfaces. Complete overhaul permitted without removing body from pipe line. Made in bronze, cast iron, cast steel or cast alloy steels. Sizes ¼" to 6". Other units available for constant differential pressure, unloading, and for remote adjustment. Inlet pressures 25 psi to 1500 psi steam at 950°F. Reduced pressures 2-600 psi.

SEND FOR BULLETIN 5302



Temperature Regulator
Class LTCO

LESLIE
TEMPERATURE REGULATORS

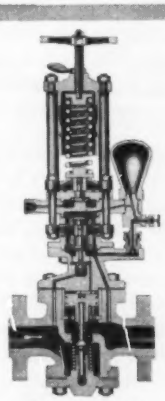
Designed for a wide range of applications. Vary the flow of steam or cooling water to heater or process to automatically maintain constant temperature. Rugged 100° F. adjustable range thermostatic element. For small and large flows, direct operated, direct and reverse acting or with "Duomatic", two-element (pressure and temperature) control. For driers, fuel oil heaters, instantaneous and storage heaters, kettles, open tanks, ovens, process heaters, degreasing machines, steam tables, sterilizers, storage heaters, urns, etc.

SEND FOR BULLETIN 5307

LESLIE
PUMP PRESSURE REGULATORS

Accurately and automatically control discharge pressure from steam operated, reciprocating or turbine driven pumps. Single seated—positive—responsive and accessible. No packed plungers or stuffing boxes. Built for constant discharge pressures of 8 psi to 2000 psi and excess pressure of 10-200 psi. For motor-driven pump discharge pressure recirculation.

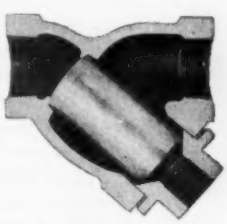
SEND FOR BULLETIN 5306



Pump Governor
Class CTHS-3

LESLIE
SELF-CLEANING STRAINERS

Recommended to protect all regulating equipment from dirt and foreign matter. Cast iron, bronze, cast steel, carbon moly, chromemoly, stainless and forged steels. Strainers with screwed, flanged, socket and butt welded connections; sizes ¼" to 10" inclusive. Primary service ratings to 2500 psi. Screens furnished in Monel and stainless steel with various perforations and meshes for liquid, gas, air, oil and steam services. For complete details on each type, ask for Bulletin 5308.



Self-Cleaning Strainer

LESLIE REGULATORS

SINCE 1900

TRADE LESLIE MARK

LESLIE CO., 235 GRANT AVENUE • LYNDHURST, N. J.

"STILL FAR AHEAD IN QUALITY AND PERFORMANCE"

The Reader AUDITED PAID CIRCULATION ABC *His Mark*

THE ABC SYMBOL, which appears at the head of this page, is your brand—the reader's brand—on this magazine. It stands for Audit Bureau of Circulations. It means that this magazine will stay in business only so long as it continues to serve its readers to their satisfaction.

That Bureau—known for short as ABC—is a voluntary, nonprofit, cooperative association founded in 1914 by a group of publishers, advertisers and advertising agencies who wanted to establish and maintain higher standards of publishing practices than then prevailed. Its primary and specific purpose was to set up yardsticks to appraise circulation values and to verify the claims of publishers as to their circulations. For the buyer of advertising space this provides an effective means to take some of the guesswork out of buying and to reconcile the conflicting claims of competing publishers. BUSINESS WEEK magazine has aptly described ABC as "the publisher's conscience—and cop."

BUT IN DOING that job, ABC performs another function of high importance to the readers of ABC member publications. It provides a constant pressure on the publishers to keep alive in their staffs a sense of primary responsibility to their readers. That is because the most simple and direct method of making a publication responsible to its readers is to place upon it a purchase price, whether by subscription or newsstand purchase. The right to purchase or to refrain from purchasing a publication gives to the reader and to no one else the power to pass effective judgment on the publisher's success in serving the reading public. Each paid publication will grow or languish, will prosper or fail, in proportion as it wins or loses the following of thousands or millions of readers. The readers, by their patronage, record their judgments as to whether the publisher and his publication are measuring up to their responsibility to them.

And that is where the ABC comes into the reader's picture. The newspaper or magazine that carries the ABC symbol on its masthead must in the first place be a paid circulation publication. Moreover, it must conform to the high standards set up by the Bureau as to terms of payment and accounting methods. And again it must open all of its books to the auditors of the Bureau on demand.

SINCE THE INFORMATION thus determined by thorough and impartial audit is periodically made public through the ABC statements and audit reports, it is constantly available to and universally used by advertisers who are considering the purchase of space in an ABC publication. These reports show the circulation trend, as verified and certified by ABC, and thus put the advertisers in a position to know whether or not the publisher is rendering satisfactory service to his readers.

Thus the publisher who submits his publication to the supervision and discipline of ABC affirms in the strongest possible manner that he recognizes his primary obligation is to his readers and that he owes his standing to a voluntary demand by those readers. It follows that the editors of ABC publications must be exceptionally alert to the desires of their readers and responsive to their needs, since any decline in circulation will soon show up in the ABC statements and audit reports.

THAT IS WHY we describe the ABC symbol as the reader's brand. It shows that a publication must be primarily responsive to him and that he holds in his own hands its success or failure. And that ABC symbol is not only a constant reminder to him of that fact, but also an equally constant reminder to all concerned that the reader's willingness to pay for the ABC publication is the acid test of its value to him and to the advertiser.

McGraw-Hill Publishing Company, Inc.

CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE

$1.50 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (See ¶ on Box Numbers.)

POSITION WANTED undisplayed rate is one-half of above rate, payable in advance.

PROPOSALS, $1.50 cents a line an insertion.

INFORMATION

BOX NUMBERS count one additional line in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

EQUIPMENT WANTED or FOR SALE Advertisements acceptable only in Displayed Style.

DISPLAYED RATE

The advertising rate is $16.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. PR.

NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y., for the December issue closing November 10th.

OVER 2000 SALES AGENTS!

The new, 1954 edition of POWER's "Directory of Manufacturer's Agents Serving the Power Field" lists over 2,000 sales agencies, in every state and in virtually every country. Limited edition. Price $10.

POWER
330 W. 42nd St., New York 36

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42 St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

MECHANICAL ENGINEER—College graduate with at least 10 years active experience in electric public utility power plant design and engineering. Some operating experience helpful. Good opportunity for right man. Address: P. O. Box #330, Hartford 15, Connecticut.

POSITIONS WANTED

MECHANICAL ENGINEER. College Graduate, Age 39. Eighteen years experience in supervision, operations, and maintenance of power generating plants. Presently employed as chief engineer, Burroughs corporation Power Plant. Partial view of turbine room appears on page 289 in this issue. Desire similar position with utility or industrial power plant. Excellent references, willing to relocate. PW-4341, Power.

POWER ENGINEER, holds chiefs license, age 31. Experience in steam electric, diesel, refrigeration, building maintenance. K. S. Clark, Bayport, Minnesota.

SALES ENGINEERS for IRON FIREMAN

Commercial-Industrial HEATING and POWER EQUIPMENT

Wanted in Several Key Markets

This company and its distributors has several immediate openings for engineers experienced in the application and sale of oil, gas and combination oil-gas package steam generators, industrial and commercial burners and other boiler room units. Iron Fireman equipment, nationally advertised for over 25 years, is used by many leading companies and institutions, and is *highly saleable*. Permanent positions. Liberal salary and bonus or commission plan if preferred. Write fully giving your qualifications.

IRON FIREMAN CORPORATION
3182 West 106th Street
Cleveland 11, Ohio

What is *Your* Problem?

Do you need competent men for your staff? Men to fill executive, sales or technical positions?

Or are you one of the readers of POWER seeking employment in any of these capacities?

Or are you looking for—or offering—a business opportunity of special interest to men in the industry served by this publication?

Or are you seeking buyers for surplus used equipment from your plant—or to buy such equipment from other plants?

The solution of any of these problems can logically be found *first* among *other* readers of—POWER. You can get their attention—at small cost—through an advertisement here.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

WANTED

WANTED
FAN COOLED BB MOTOR & STARTER

One 125 HP and One 200 HP, 900 or 1200 RPM, and Two 50 HP, 900 RPM, 3-60-440, Open or totally enclosed.

JOSEPH BEHR & SONS, INC.
1246 Seminary St., Rockford, Ill. Dial 2-7721

WANTED
Complete Power House

Approximately 10,000 KW including coal handling equipment—boilers—turbo generators and all auxiliaries. Must be modern, excellent condition and complete.

SOUL CLINIC INC.
CALGARY, CANADA

FOR SALE

(Additional For Sale Ads on pages 280-289)

FOR SALE
100 H.P. Fairbanks-Morse Diesel Engine

Model 32D12 Style VA, 2 cylinder upright 360 RPM with starting air tanks and compressor direct coupled to 3 phase 220 Volt 88 KVA generator.

THE ECLIPSE GLASS COMPANY
THOMASTON, CONNECTICUT

FOR SALE
TWO 30,000 GALLON PROPANE TANKS

Complete with unloading equipment, pumps, valves and piping. One tank is two years old, the other one year. These tanks are suitable for use with anhydrous ammonia.

Contact City Engineer, Waverly, Iowa

25000 KVA AUTOTRANSFORMER

General Electric, Type HT, Form DD, 60 cycle, 3 phase serial 4126955, 0.812% impedance, 55° C. continuous, circular coil design, voltage rating—69300 Primary, 66000 Second. KVA rating as a two winding transformer—2500 KVA—with any voltage combination from 66 KV to 2.4 KV.

Some Possible Ratings as an Autotransformer on Standard Voltages

PRIMARY KV	SECONDARY KV	KVA RATING
67	43.8	6500
67	34.4	4650
67	22.9	3450
34.4	22.9	6800
34.4	13.8	3750
34.4	13.2	3700
34.4	12.47	3550
34.4	12.0	3500
22.9	13.8	5700
22.9	13.2	5400
22.9	12.47	5000
22.9	12.0	4750
22.9	8.32	3550
22.9	7.2	3350
13.8	7.2	4750

We Will Rewind This Transformer To Your Specifications

TRANSFORMERS—1 ph. 60 cy.

Each of the following transformers can be supplied with almost any voltage combination, using proper bushings and new oil. Let us know your needs—We can fill them quickly.

3—3333 KVA 66000 to 33000 to 13200
1—1000 KVA 33000 to 11000 to 2300
2—1000 KVA 13800 to 2300
3—1000 KVA 11000 to 2300
11— 500 KVA 38100/66000Y to 2300
1— 200 KVA 60000 to 2300
3— 200 KVA 33000 to 2300/4600Y
1— 200 KVA 33000 to 2200/13200
1— 200 KVA 12000 to 2300/460
1— 150 KVA 66000 to 2300/4000Y
1— 150 KVA 58500/66000 to 2300/4000Y

DIESEL GENERATORS

300 KVA Superior YLO—G.E. Generator 480 rpm 3/60/440/2200

TURBO GENERATORS

1500 KW G.E. Non-Cond. 140 lbs. 3/60/2300
1000 KW West. Cond. 185 lbs. 3/60/2300
1000 KW G.E. Non-Cond. 140 lbs. 3/60/2300
750 KW G.E. Cond. 150 lbs. 3/60/2300
500 KW West. Non-Cond. 175 lbs. 3/60/2300

PUMPS—BOILER FEED

600 GPM 1220' hd DeLaval 3550 rpm 5x4
400 GPM 1250' hd Werth. 1750 rpm 5x4

GENERATORS—GAS ENGINE

99¾ KVA 3/60/230 Star Buda with charger
62½ KVA 3/60/240 4 wire Waukesha-Bardco Type C12 truck mounted

BOILERS

1—350 HP Hedges-Walsh-Weidner 225 psig

CENTRIFUGAL PUMPS

5200 GPM 55' hd Worthington 18x14, 1150 rpm
5000 GPM 214' hd Penna. 15½x14, 1775 rpm
3750 GPM 25' hd Allis-Ch. 14x14, 865 rpm
3500 GPM 37' hd DeLaval 12x12, 1160 rpm
3200 GPM 50' hd Gard.-Denver 10x12 1160 rpm

AIR COMPRESSORS

570 CFM, 17x12, 45 psi, single stage Ingersoll-Rand, Type ER-1, 85 HP
500 CFM, 100 psi, two stage, Ingersoll-Rand Type 40, Portable Diesel Driven
335 CFM, 14x10, 100 psi, single stage Ingersoll-Rand, Type ER-1, 100 HP
242 CFM, 12x8, 40 psi, single stage Ingersoll-Rand, Type FR-1, Steam Driven

TAMPA ARMATURE WORKS INC.

401 S.MORGAN ST. TAMPA, FLORIDA PHONE 2-1966

M-G SETS!

1—500 KW, 240 V D.C., Whse. M-G Set, 900 RPM, Syn. Drive, 3/60/2200. Ser. 4979926 with magnetic reduced voltage starter.
3—400 KW—270 V DC G.E. 3/60/2300/900 RPM Syn. Drive. 3 Brg. Complete w/AC & DC panels. Ser. #4,098,425-26-65.
1—200 KW, 125 V D.C., Type PED, Ser. 576881, E-M Set, 900 RPM. Syn. drive. 3/60/2300 (4160.)

TURBO-GENERATOR

1—750 KW, Elliott AC Generator, Frame 3232, 3600 RPM, 3/60/180. Elliott Turbine, Inlet 200# ga. 112 deg. F. superheat, 28" hg. vac. exhaust. Complete with accessories.

SYNCHRONOUS CONDENSER

1—1000 KVA, Allis-Chalmers, 3 phase, 60 cycle, 2300 volts, 600 RPM

SYNCHRONOUS MOTORS

1—200 HP, F-M, 300 RPM, Type TZO, Frame 5
1—200 HP, E-M, 900 RPM, Type PED, 2300/4160V
1—150 HP, G.E., 277 RPM, Type ATI, 2300V

MOTORS

Amt.	HP	Speed	Make	Type	Frame
3	250	600	G.E.	KT368 (2200V.)	
1	150	1800	Whse.	CS(2200V.)	871S
1	150	1800	A-C	2200V.	
1	150	900	G.E.	I-K(2200V.)	15
1	125	1800	Whse.	CS	
1	100	1800	Whse.	CS	663C
1	100	1200	Whse.	CS	752C
1	100	900	G.E.	MT356 Slpr	
1	100	900	A-C	2300V.	

BENSON-WILIMZIG, INC.

1708 North 8th St. St. Louis 6, Missouri
Phone—GArfield 1-4290

BARGAINS

1000 K.W., 3-60-2300 volt, 3600 RPM, Gen. Elec., rigid frame Turbo Generator, 300 lbs. condensing, for $3000.00 on Cars.

750 KW., 3600 RPM, Gen. Elec., rigid frame extraction type turbo Generator, good up to 200 lbs. pressure & 15 lbs. extraction with Generator, Cheap.

150 KW., Unused, Westgh. Turbine, 225 lbs. pressure, 25 lbs. back pressure with extended base for Generator.

A. C. H. Wheeler tube jet air ejector, inter and after condensers, capacity 2000 lbs. per hour free air at 3.5 lbs. for $400.00.

6—200 KVA, Allis Chalmers transformers, 2300 to 115-230 volts, at $450.00 each, FOB Truck

2—500 KW., 230/115 Volt, 3 wire, 1200 RPM, Gen. Elec. Rotary Converters

1—300 KW., 230 Volt, 1200 RPM, type MCP, Gen. Elec. motor generator

1—4000 amp, 10-20 volt, Hansen Van Winkle Munning Generator, to a 75 HP, 3-60-440 volt, 600 RPM, Gen. Elec. syn. motor

40—20 to 50 HP, high speed, new Lewis Allis ball bearing motors at special prices

We carry a large stock of Motors, A.C. and D.C., Transformers, Motor Generators, Turbo Generators, and etc.

WE SOLICIT YOUR INQUIRIES.
WHAT HAVE YOU FOR SALE?

KEYSTONE POWER PLANT EQUIPMENT CO.

8403 Hegerman St., Phila. 36, Pa.

BALL MILLS

1—Kennedy Van Saun 3' D x 6' L Contin. Steel Lined Ball Tube Mill

1—Allis-Chalmers 6' D x 16' L Contin. Steel Lined Ball Mill

BOILER

1—Cleaver Brooks OB-35 Package Boilers, oil fired, 350 HP, 125# Pr.

PERRY EQUIPMENT CORP.

1422 N. 6th St. Philadelphia 22, Pa.

NEW UNUSED
1000 KVA CONDENSING TURBINE GENERATOR

1000 KVA—750 KW, 75% PF, General Electric alternating current generator, 3 phase 60 cycle, 450 volt, 1200 RPM dct connected through reduction gear to a:

750 KW General Electric condensing steam turbine, 10033 RPM, 375-440#, 740°TT.

UTILITIES MACHINERY CORP.

1965 E. SIXTH ST., CLEVELAND 14, OHIO

COMPLETE POWER PLANTS

STEAM — ELECTRIC — HYDRO — DIESEL

BOILERS *"Export Orders Carefully Executed"* BOILERS

TRY US with your INQUIRIES for ALL POWER MACHINERY

CHARLES B. REARICK 30 CHURCH ST. NEW YORK 7, N. Y.

WOUND ROTOR BARGAINS

2—300 HP 1800 RPM 3 phase 60 cycles 4160 volt Westinghouse Wound Rotor Motors Ser. 4531669, 4889284.
2—200 HP same as above G.E. Wound Rotor Ser. 4319835, 4294611.
Price F.O.B. Cars Denver as removed from service $2000.00

ELECTRIC EQUIPMENT & ENGINEERING CO.
40 West 49th Ave., Denver, Colorado

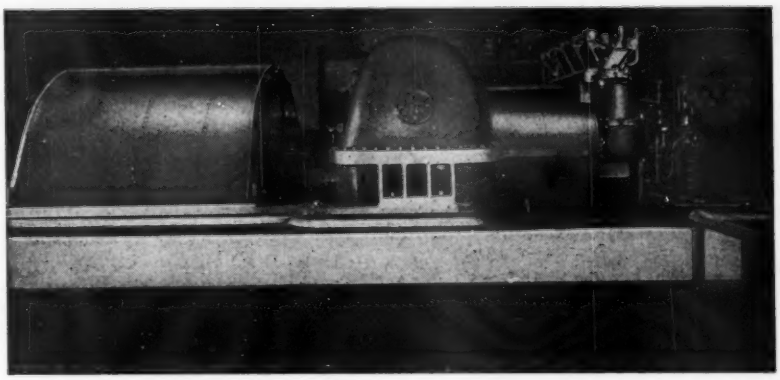
3750-KVA. ALLIS-CHALMERS-400# PSIG, 750° F.T.T. TURBINE-GENERATOR NEW 1948-EXCELLENT CONDITION

Above view of our Allis-Chalmers 3750 KVA Condensing Turbine Set, just released, offered here for the first time, is complete with 2-pass Surface Condenser capable condensing 34,500# steam per hour, Switchboard with Instruments, Exciter direct connected and has had limited service and ready now for immediate delivery. Voltage: 3/60/2300/4160 Volt. Steam Pressure: Initial 400# PSIG, 750° F.T.T.

OTHER UNITS AVAILABLE:

1—2000 KW Gen. Elect. Cond.—440#—750° F.T.T.—2300 V.
1—2000 KW Al.-Chal. Cond.—400#—750° F.T.T.—2300 V.
1—1500 KW Gen. Elect. Cond.—410#—750° F.T.T.—2300/4160 V.
1—2000 KW West., Non-cond.—250#—600° F.T.T.—40# B.P., 2300 V.
1—1250 KW West., Non-cond.—150#—600° F.T.T.—15# B.P., 2300 V.
1—1250 KW Gen. Elect., Non-cond.—200#—600° F.T.T.—15# B.P., 480 V.
2— 750 KW West., Non-cond.—150#—600° F.T.T.—15# B.P., 2300 V.

3750-KVA. G. E., 400#, 750° F.T.T. TURBINE-GENERATOR



Above view was made from a recently taken photograph of the 3750-KVA, G.E., Turbine. It is a condensing machine complete with 2-pass, 6000 sq. ft. Surface condenser, Switchboard with instruments, D.C. Exciter. Voltage is 3/60/2300-4160-V.

MACHINE CAN BE INSPECTED IN OPERATION

We own and offer any Capacity Turbine from 300-KW to 12,500-KW. Complete line of Boilers, also Diesel Engines. Send us your specs.

TELEPHONE WIRE OR WRITE.

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4145 PENOBSCOT BUILDING
DETROIT 26, MICHIGAN

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with CHICAGO ELECTRIC GUARANTEED "REBUILTS"

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POWER EQUIPMENT FOR ALL INDUSTRIAL NEEDS

CHICAGO ELECTRIC's modern plant houses one of the nation's largest stocks of guaranteed rebuilt power equipment; is

- AC & DC MOTORS
- GENERATORS
- M.G. SETS
- FREQUENCY CHANGERS
- ROTARY CONVERTERS
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- TRANSFORMERS
- CONTROLS

plus a big selection of allied equipment such as HOISTS, CRANES, AIR COMPRESSORS, FANS, BLOWERS, REDUCERS, BOILERS and PUMPS . . . so, whatever you need and whenever you need it . . . be sure to check with CHICAGO ELECTRIC first!

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	Make	Type	Speed
1500	*G.E.	MT-30	240
1250	*Westg.	CW	600
1000	*Westg.	CW	250
700	*Al-Ch.	ANY	720
600	G.E.	MT-567	1800
600	*Westg.	CW	450
600	*G.E.	I-P	257
500	Westg.	CW	350
400	Al-Ch.	5 brg.	450
400	*G.E.	MT-412	450
300	*G.E.	IE-15A	1800
300	*G.E.	MT-568	720
250	Westg.	HF-15H	600
200	*Westg.	CW	1200
200	G.E.	IE-15B	900
200	G.E.	IM	600
150	Cr. Wh.	50-R	1800
150	G.E.	MT-549	1800
150	*Al-Ch.	ANY-30F1	1200
150	Westg.	CW-568A	720
125	G.E.	IM-15A	600
100	G.E.	IT-12A	1800
100	G.E.	IM	600
100	G.E.	IM	450
75	Nor. West.	HW-56	1800
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al-Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al-Ch.	ANY-26F	900

SLIP RING MOTORS

Crane and Hoist Service
3 phase, 60 cycle, 220 or 440 volt

H.P.	Make	Type	Speed
75	Westg.	CI-756A	600
50	Westg.	MW-334	600
50	G.E.	HIC TENV	600
35	G.E.	MTC-5536	600
22	G.E.	ITC-5009	1200
20	Westg.	CI	1200
15	G.E.	ITC-5010	720
11	Westg.	CI-E464	900
10	P & H	BW-6	1800

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000 (3u)	Westg.	11000	137/275
500	Westg.	2300	137/275
500	Westg.	2300	275
400	A.C.	2300	120/240
300	G.E.	2300	250
200	G.E.	2300	250
200	Westg.	4160	250
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	G.E.	4000	250
150	A.C.	2300	275
150	G.E.	440	275
100	Westg.	440	125
100	El. Mch.	440	125
100	G.E.	240	230
100	G.E.	440	125
90	G.E.	440	60
75	G.E.	440	125
60	Westg.	2300	125
60	A.C.	2300	125
50	Reliance	440	250
50	Ideal	2300	250
50	Westg.	240	125
40	G.E.	440	125
40	G.E.	440	250
35	Westg.	2300	150
30	G.E.	440	125
30	Westg.	2200	125
25	L-Allis	440	250
20	Bogue-GE	550	250
20	Bogue-GE	220/440	250
20	Bogue-GE	440	125
15	Westg.	220/440	250

PUNCH PRESS MOTORS

NEW—3/60/220-440 volt
High Torque—High Slip

H.P.	Make	Type	Speed
60/45	G.E.	KH-6325	1090/790
60	Westg.	CS-752-C	1060
60	Westg.	CS-857-C	1085
50	Westg.	CS-505	1080
50	Imperial	E-1584	1090
40	Reliance	AA-B-506	1635
40	Imperial	E-505	1080

SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volt (*2300 volts or higher)

H.P.	Make	Type	Power Factor	Speed
1420	*West.		.7	900
720	*West.		1.0	900
710	*G.E.	ATI	1.0	720
600	*G.E.	TS-7640	1.0	900
500	*G.E.	TS-7657	1.0	514
400	*West.	H	.8	1800
400	West.	HG	1.0	900
300	G.E.	ATI	.8	900
300	G.E.	ATI	.8	720
300	*Ideal	SMM	.8	257
300	G.E.	ATI	.8	1200
250	G.E. New	TS-974Y	.8 (3brg)	720
225	G.E.	TS-6244	1.0	300
225	El. Mch.		1.0	360
200	F-M	TJC-285	.8	720
190	El. Mch.		1.0	720
150	F-M	TJC-285	.8	720
150	G.E.	ATI	.8	720
150	*El. Mch.		.8	1200
150	Westg.	HR	1.0	300
125	*G.E.	TS-7641	1.0	514
125	*G.E.	TS-6214	1.0	277
125	*El. Mch.			900

D. C. MOTORS—230 Volt

H.P.	Make	Type	Speed
250	Westg.	SK-220	450/600
250	Westg.	SK-201	650
200	Cr. Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	CDP-115	1750
100	G.E.	RC-19	575
100/150	G.E.	MCF	380/1000
75	G.E.	RCP-34	1750
50/120	G.E.	MCF	250/1000
50	G.E.	RC-31B	1700
50	Cr. Wh.	CMC	700/1100
50	G.E.	DLC-204	650
35	Westg.	SK-150	350/1000
30	Cr. Wh.	CCM-504	450
30/40	G.E.	CD-115	500/1500
25	G.E.	RC-32	800

CHICAGO *Electric Co.* 1320 WEST CERMAK ROAD, CHICAGO 8, ILL.

Immediate Delivery

AIR COMPRESSORS

1—NEW, I. R., PRE-2, 3580 CFM @ 110 PSI, 600 HP, Synch. Motor, Exciter & Controls.

1—665 CFM, 100 PSI, Worthington, hor., duplex, 125 HP Synch. Motor, Exciter, and Controls.

1—1800 CFM, I. R., PRE-2, 100 PSI, 300 HP, 2300 Volts, Synch., 225 RPM.

1—1800 CFM, Bury, VCCE, 100 PSI, 300 HP, 440 Volts, Synch., 225 RPM.

BOILERS

9—304 HP, Kewanee, Firebox, Model 590, 125 PSI, ASME with soot blowers.

4—150 HP, Casey Hedges, HRT, 150 PSI, ASME, gas fired.

1—50 HP, Titusville, 150 PSI, adaptable gas or oil firing.

HEAT & POWER CO., INC.
70 Pine St., New York 5, N. Y.
HAnover 2-4890

FOR SALE

AIR COMPRESSOR

640 CFM, 100 lb., Ing-Rand Imperial Type XCB Duplex, 2 stage, V-Belt Driven 100 HP, 440 volt, Motor and Starter, 42"x10' Receiver, Intercooler, as removed from service. $2500.00. F.O.B. Warehouse Newark, New Jersey.

FLUSHING ELECTRIC CORP.
45-07 162nd St., Flushing 58, N. Y.

SAVE UPWARDS OF $75,000
140,000 #/Hr.—450# W.P.
NEW—UNERECTED BOILER
COMBUSTION ENGINEERING CO.
Type VU-50 with Waterwalls
FS-4251, POWER
330 W 42 St., New York 36, N. Y.

FOR SALE

2 American Marsh Steam Vacuum Pumps—Size 25" x 16" x 20"—In Perfect Condition. Price: $800.00 ea., F.O.B. Washington, D.C.

S. E. DOCKSTADER, INC.
1025 Brentwood Rd., N.E., Wash'tn 18, D.C.

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE — Two Rector St., New York 6, N. Y.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
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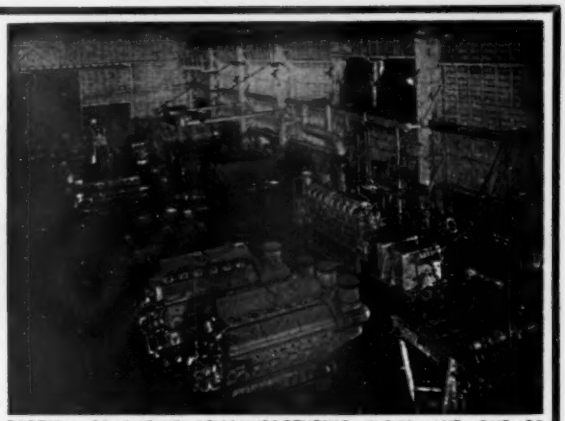
EDDYSTONE, PENNA. AND SAUSALITO (S.F.), CALIFORNIA



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
600	General Motors	12-567	900	600
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
*150	Worthington	CC-4	225	450
148	Fairbanks Morse	32E14	225	300
100	General Motors	3-268A	150	1200
60	General Motors	6-71	90	1200

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED
*—indicates NEW unit

ONE YEAR GUARANTEE!

3—333 KVA—1-60-33000 to 2300/4000 V. General Electric outdoor transformers.
4—100 KVA-3-60-2400-120/208 V. Pyranol transformers each with 275 A. 600 V. 3 pole air breaker.
1—150 HP-900 rpm-440-3-60 GE synchronous motor exciter and automatic starter.
1—100 HP-870 rpm-440-3-60 NEW Elec. Mach. Mfg. Co. Magnetic Drive and Regutron Control.

H. BLAINE JOHNSON & ASSN.
53 W. Jackson Blvd. Chicago 4, Ill.

POLE LINE SWITCHES

Q.	Make	Type		Volt	Amp.	Control	Int. Cap.
12	Condit	PK-5	3 pole	4,500	200	Non-Auto.	10,000
10	El. Spec.		3 pole	7,500	200	Non-Auto.	10,000
2	Condit	P-50	3 pole	7,500	200	Motor	15,000
7	Westg.	FO-22-A	3 pole	7,500	400	Elec.	50,000

W. B. McCLURE, 105 Stoy Ave., Westmont, N. J.

---

400 KW NON-CONDENSING TURBINE GENERATOR

500 KVA—400 KW, 80% PF Allis Chalmers generator, 3 phase 60 cycle, 480 volt, 1200 RPM connected through reduction gear to a:

400 KW Terry non-condensing turbine, 325-400#, 100-125# gauge back pressure, 3800 RPM. Direct connected exciter, switchboard, instruments, spare parts. RECONDITIONED.

UTILITIES MACHINERY CORP.
1965 E. SIXTH ST., CLEVELAND 14, OHIO

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BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.
5331 Hetzel St. **Cincinnati 27, Ohio**

40 Years' Dependable Service

SOMEBODY—SOMEWHERE,
needs your idle equipment! Reach that buyer quickly and economically thru the

"SEARCHLIGHT SECTION"

The meeting place of Used Equipment Buyers and Sellers

INVESTIGATORS WELCOME!

THE CLOSER YOU LOOK
THE MORE YOU'LL BE SATISFIED
WITH THE QUALITY AND ECONOMY OF

HEMPHILL *Guaranteed* EQUIPMENT

OIL CIRCUIT BREAKERS

3—600 AMP. G. E. FKR-55-20, 15,000 V.
3 P. 100,000 KVA, SOLENOID OPER.

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
2	3750	G.E. new	OISC	3	26,400x4360
1	1000	G.E.	Auto	3	4150x2400
1	1000	Amer.	OISC	3	4160x480
1	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4800-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts.	OISC	1	4800/4150/2400 x240/480
1	333	G.E.	H	1	13200x220/440
1	300	G.E.	H	1	13200x440
4	300	G.E.	H	1	13200x440
1	200	G.E.	HT	3	2400x240
2	150	Pitts.	ODSC	1	240x120/240
3	50	G.E.	H	1	4800x120/240
3	50	A.C.	H	1	230x120/240
3	50	G.E.	H	1	460x115/230
3	50	Whse. new	OISC	1	2400x240/480
3	37½	G.E.	H	1	2400x120/240
1	25	G.E.	H	1	460x120/240
5	25	Niag.	OISC	1	2300x480
1	25	Allis	PBSB	1	480x12240

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	80	CW	440
2	200	Whse.	600	CW	440
1	200	G.E.	600	MT	440
1	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	100	G.E.	600	IM	440
1	75	G.E.	600	IM	440
3	60	G.E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G.E.	1200	MPC
2	150	C.W.	900	WP
1	125	G.E.	1700	BC
2	75	C.W.	900	WP
1	30	C.W.	700	CM
1	35	G.E.	860	BC
1	25	Whse.	835	SK

NEW COMPLETE OUTDOOR SUBSTATION

2—3750 KVA, G.E. type OA, 4687 KVA forced air, 26400 volts pri., 2 taps above and below, 4360/2520 volts sec. with fans, steel structure, outdoor, 1-million KVA interrupting breaker, etc. Purchased 1951, never used.

60	G.E.	1200	KT		220
50	G.E.	3560	FT		220
50	G.E.	600	KT		440
40	G.E.	3550	FT		440
30	G.E.	600	KT		440

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 Syn.
1	1000	Whse.	720	600	2300/4150 Syn.
1	750	Whse.	720	275	2300/4150 Syn.
1	300	C.W.	1200	230	3-unit 2400/4150SR
1	300	G.E.	1200	230	2400/4150SR
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C.W.	1200	230	440 SC
1	150	3 Unit G.E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C.W.	1200	125	2300 S.C.
1	100	G.E.	900	250	2300 Syn.
3	60	G.E.	1200	125	208 Syn.
2	30	G.E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	300	Whse.	720		4150
1	175	G.E.	720	ATI	2300
1	150	G.E.	720	ATI	2300
1	150	G.E.	1800	TS	220
1	150	Whse.	900	ISIG	220

SPECIAL

A.C. Welding MG Set

176 KVA 1200 RPM 1 Phase 220 V. 800 Amps.
57 PF motor 1160 RPM. 440 2 3 Ph. S.R.
direct connected exciter and flywheel.

• THE HEMPHILL SEAL OF *Satisfactory* SERVICE

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PHONE NEW YORK—LONGACRE 3-3227
PHONE NEW JERSEY—UNION 3-2600

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GAS • DIESEL • STEAM • ELECTRIC
NEW AND QUALITY REBUILTS

STATIONARY

80 CFM 6x5 Worthington HB—10 HP Elec.
122 CFM 7x7 Worthington HB—20 HP Elec.
170 CFM 6¼x4½ Davey VB9—25 HP Elec.
242 CFM 125 PSI 8x7 Joy WG-9—40 HP Elec.
270 CFM WL-60 Joy Gas and Elec 50 HP
294 CFM 125 PSI 10x11 Worthington HB
364 CFM 20 PSI 12x7 Gardner Denver RX
368 CFM 100 PSI 12x10 IR-ER-I
552 CFM 125 PSI—13/8x10 Ingersoll Duplex
931 CFM 55 PSI 17x13 Chicago T-B
1085 CFM 35 PSI 20x12 Pennsylvania
MANY OTHERS TO CHOOSE FROM
AFTERCOOLERS • AIR RECEIVERS

PORTABLE

55 CFM Lindsay (Gas)
60 CFM LeRoy-Worth (Gas)
105 CFM Joy-Worth-CPT (Gas)
160 CFM Worthington (Gas)
210 CFM Worthington (Gas & Diesel)
270 CFM Joy w/Buda Power Unit—Skids
315 CFM Worthington (Gas & Diesels)
500 CFM Worthington (Diesel)
600 CFM Worthington (Diesel)

VACUUM PUMPS

180 CFM 10x4 Ingersoll—10 HP
354 CFM 14x5 Penn—15 HP
434 CFM 14x7 Ingersoll 15-20 HP
800 CFM 18x9 Worthington—30 HP
1635 CFM 24x11 Chicago—60 HP
5881 CFM 30 & 30x12 Ingersoll XVH

American
AIR COMPRESSOR CORP.
DELL AVE. & 47 th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-4848

REBUILT—GUARANTEED ELECTRICAL EQUIPMENT

Several Larger Items
Selected from Our Stock

MOTOR GENERATOR SETS

Qu.	KW.	Make	R.P.M.	Volts D.C.	Volts A.C.
1 (3-U)	2400	Whse.	720	600	4800/2400
2	1200	Whse.	720	600	2300
1	500	C.W.	720	275	2300/440
1	400	C.W.	1200	125/250	440
1	300	G.E.	720	275	2300
2	200	G.E.	720	250	2300/440
1	150	G.E.	720	250	2300/440
1	100	Whse.	900	275	2300
1	100	C.W.	1200	125	440/220
1	85	C.W.	1200	250	4000/2200

SYNCHRONOUS MOTORS
3-Phase, 60-Cycle

Qu.	H.P.	Make	P.F.	Volts	R.P.M.
1	3000	Whse.	.80	4800/2400	720
2	2100	G.E.	1.00	2300	360
2	2000	G.E.	.80	2200	720
1	800	El. Mchy.	.80	440	1200
1	750	G.E.	.80	2300	450
1	300	G.E.	.80	440/220	900
1	250	G.E.	1.00	2300	514
1	250	Whse.	.80	440	600
2	200	Whse.	.80	440	1200
1	187	G.E.	.80	440	720
1	150	Whse.	.80	440/220	450
2	135	G.E.	.80	4000/2200	1200

TRANSFORMERS

Qu.	KVA	Make	Phase	Voltage
3	750	Pitts.	1	23,000-2300
3	667	Wagner	1	22,000/11,000-2300/4000
3	500	G.E.	1	22,000/11,000-2300/4000
3	333	G.E.	1	13,200-2300
3	250	G.E.	1	2400-240/480
2	150	G.E.	3	2400/4150-240/480
3	100	G.E.	1	33,000/2300

T.B. MAC CABE COMPANY
Phone
614 CLARION STREET — PHILADELPHIA 40, PENNA.

FOR SALE

(5) OIL FIRED B&W BOILERS
75,000 lbs. per hour—11,147 sq. ft. heating surface — 200 lbs. working pressure. Cross drum—sectional header—30 sections wide. IN EXCELLENT CONDITION. LOCATED BALTIMORE, MD.

(2) EX-LIBERTY SHIP BOILERS
24,000 pounds per hour—4890 sq. ft.—225 pounds working pressure. Made by Combustion Engineering Co.

(3) SCOTCH MARINE BOILERS
225 pounds working pressure. Approximately 17,500 pounds each, per hour. 1943.

(4) 300 KW G.M. 8-268A DIESEL GEN.
G.M. diesel generator sets—120/240 volts DC—1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

(6) 300 KW TURBO GENERATOR SETS
120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stabilized shunt generator. With switchgear. Built 1945. Excellent condition.

COCHRANE DEAERATOR
220,000 lbs./hr.—1800 gal. storage volume—max. pressure 20 lbs.

MOTORS AND GENERATORS—all sizes

THE BOSTON METALS CO.
313 E. Baltimore Street
Baltimore 2, Md.
Curtis 7-5050

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150 & 125 HP Scotch Marine Boilers
60 HP Oil Fired Scotch Marine Boiler
11,400 & 20,000 Gal. Storage Tanks
36" Wide Belt Conveyer—LIKE NEW
62½ KVA Non-Cond. Turbo Gen. Set
20 HP Vertical Gas Fired Boiler
84x20' & 72x18' HRT Boilers
85'x4'x¼" Steel Smoke Stack
H. & P., 6719 Etzel, St. Louis 14, Mo.

RE-NU-BILT
GUARANTEED
ELECTRIC POWER EQUIPMENT

D. C. MOTORS

Qu.	HP	Make	Type	Volts	RPM
1	2200	G.E.	MCF	600	400/500
1	2000	Whse.	Mill	600	230/460
1	1200	G.E.	MCF	600	750/950
1	940	Whse.	QM	250	140/170
1	900	Whse.		250	450/550
1	825	Whse.		250	95/190
1	600	Al. Ch.		250	400/800
1	500	Whse.	CC-216	600	300/900
1	500	G.E.	MCF	600	300/900
2	450	Whse.		550	415
1	200	Whse.	CB-511.3	250	400/800

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G. E.	MT-498	2300	360
1	1500	ABB		2300	720
1	1200	G. E.	MT	2300	275
2	1000	A. C.	Mill	2300	240
1	1000	G. E.	MT-452	2200	321
1	500	G. E	M-574Y	6900	900
1	500	Whse.	CW	550	350
1	450	G. E.	IM	440	720
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G. E.	MT-442 Y	2200/4000	253
1	350	G. E.	IM-17A	440/2200	720
1	250	G. E.	MT-424-Y	4000	257
1	250	G. E.	MT-559S	2200	1800
1	250	Al. Ch.		550	600

SQUIRREL CAGE

2	650	G. E.	FT-559BY	440	3570
2	450	Whse	CS-1420	2300/4150	354
1	300	Whse.	CS	440	1170
1	200	G. E.	IK-17	440	580
2	200	G. E.	KT-557	440	1800
1	150	Whse.	CS-856S	440	880
1	150	Whse.	CS	440	580
1	150/75	G. E.	IK	440	900/450
2	125	Al. Ch.	ARW	2200	1750

SYNCHRONOUS

1	4350	C. W.	3501-8L	13800/6900	514
2	2100	G. E.	ATI	2300	360
2	1750	G. E.	ATI	2300	3600
2	2000	Whse.		2300	120
3	735	G. E.	ATI	2200/12000	600
1	720	G. E.	TS	2300/4600	720
1	500	Ideal	SM	2300/4160	1800
1	500	Whse.		440	900
1	450	Whse.		2200	1285
1	450	Whse.		2200	450
1	400	G. E.	TS	2200	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G. E.	450	250/300	2300/4600
2	2000	G. E.	450	600	2300/4600
1	2000	G. E.	500 25cg	665	11000
2	2000	G. E.	514	600	6600/13200
1	1500	G. E.	720	600	6600/13200
1	1500	C. W.	514	30/115	4000/13000
3	1000	G. E.	720	600	2300/4600
1	1000	G. E.	900	260	6600
1	750	C. W.	514	30/115	2300
1	600	G. E.	720	250	440/2300
1	500	Whse.	1200	115/230	2300

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	5000	Whse.	OISC	3	3300x2640
1	2500	Whse.	OISC	3	26400/13200x46
3	2000	G E.	HVDDJ	1	66000/13800
3	667	G. E.	HD	1	13800x2300
3	1000	G. E.	HVDDJ	1	2400x480
6	1000	Wagner	OISC	1	13200x46

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25	13200/13200
1	3000	G. E.	60/25	2300/2300/4000
2	2500	G. E.	25/62.5	2300/2300
1	1000	G. E.	25/58.3	4400/2300
1	500	Al. Ch.	2560	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G. E.	Condensing 425—750 F. T. T. Surface Condenser 3/60/2300/4000 V Direct conn exciter
1	1500	Whse.	Auto-extraction 190 lbs.—600° F.T.T. 60 lb. extraction 3/60/240 V. Dir. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G. E.	Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944.
1	750	Whse.	—Non-condensing 15# I.S.P. 40# B.P. 750 Kw. 280 V. D.C.

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.

NOW IS THE TIME TO BUY....
"Certified Rebuilt" Motors and Generators
HIGHEST QUALITY . . . REDUCED PRICES
Check with WAGNER *First*

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
625	Gen. Elec.	ATB	2300	450
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis Ch.	1 brg.	480	400
350	El. Machy.	1 phase	480	1200
312	Gen. Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec.	ATB	2300	900
150	Whse.		2300/480	600
125	El. Machy.	Syn.	240/480	1800
125	Gen. Elec.	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200
25	Whse. b.b.	1 phase	120/240	900
10	Kato b.b. New	3 phase	127/220	1800

LOW VOLTAGE M-G SET
Whse. 3636 amp. 20/55 V DC gen. w/synch. motor 220/440 V. 720 RPM and exciters.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b.	EW	250	1200
250	Gen. Elec.	MPC	250	600
175	Allis Ch. b.b.	EW	250	900
150	Gen. Elec. b.b.	CDM	250	1500
105	Century b.b.	1500 amp.	70	1200
100	G.E.	CD	250	1500
100	Allis Ch.	E	125	1200
100	Allis Ch.	E182	250	900
100	Delco b.b.	Mar.	125/250	1200
75	Cont. b.b.	D109X	125	1150
75	F. M. b.b.	DH	125	1800
75	G. E. b.b. (2)	CDM135	125	750
75	Whse.	SK	250	900
75	Columbia b.b.		120/240	1450
60	Allis Ch.	E147	250	900
60	Whse. b.b. (2)	SK121	300	1200
50	Cr. Wh. b.b.	CCD	250	1800
50	Reliance	T	250	1150
40	Gen. Elec.	CD103	250	1500
40	Gen. Elec.	RC	600	1750
35	Gen. Elec.	RC31B	240	1750
25	Whse.	SK93	125	1750
25	C. W. b.b. (2)	CCD	250	1200
20	Gen. Elec.	RC	125	1150

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Allis Ch.	Slipring	440	600
750	G. E.	Synch.	2200	514
600	E. M.	Synch.	480	1200
550	G. E.	Sq. Cage	2200	3600
500	G. E.	Sq. Cage	4000	1800
500	G. E.	Slipring	2200/440	450
500	G. E.	Synch.	440	900
450	Allis Ch.	Synch.	480	400
400	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis Ch.	Sq. Cage	2200/440	1200
350	Whse. (2)	Slipring	2300	450
300	G. E. (2)	Slipring	2200/440	720
300	El. Machy	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G.E.	Slipring	440	360
250	F. Morse b.b.	Slipring	440	600
250	G.E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	G.E.	Slipring	220/440	1800
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slipring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Slipring	220/440	360
200	E. M.	Synch.	220/440	514
200	Wagner	TEFC	2200	1200
175	G. E. (2)	Synch.	220/440	720
175	Whse.	Synch.	220/440	360
150	Whse.	Slipring	220/440	900
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	G. E.	Synch.	220/440	450
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G.E.	Slipring	220/440	450
150	Allis Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
150	G.E. vertical	Slipring	4000/2300	1200
125	Whse.	Sq. Cage	220/440	900
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E.	Slipring	220/440	450
125	E. M.	Synch.	220/440	1800
125	Allis Ch.	Slipring	220/440	900
100	G.E.	Slipring	220/440	514
100	Burke b.b.	Synch.	220/440	1800
100	G. E.	Slipring	220/440	900

48 Years of Service to American Industry

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
300	Gen. Elec.	MPC	250	500
200	Allis Ch. b.b.	EW	250	650
150	Whse.	SK-201	230	300/900
150	G.E.	RC-16	230	1650
100	G.E.	CD123	230	1150
100	Allis Ch.	E182	230	600/1200
75	F. Morse b.b.	DH-140	115	1600
75	Whse.	SK170	230	635
50	Reliance	510T	230	850
50	Reliance b.b.	651T	230	750
50	Cr. Wh. b.b.	FH	230	1750
50	Whse.	SK185	230	300/900
40	Whse.	SK143	230	600/1500
40	Reliance	651T	230	350/1000
40	Allis Ch.	E-121	230	1750
40	Gen. Elec. (2)	CD103	230	1150
40	Gen. Elec.	RC32	550	1200
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	Star b.b.	SB	230	1750
25	L. A. TEFC	RNA	220	850
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD105	230	575/1720
25	Whse.	SK100L	230	1150
20	Century b.b.	DN326	230	3500
20	Ct. F series	CO-1826	230	875
20	Allis Ch.	E-100	115	1150
15	G.E. (2)	CD75	115	1750

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
1000	G.E.*	6600 AC	600 DC
500	Whse.*	2300-AC	250 DC
300	G. E.*	440 AC	250 DC
300	Allis Ch	2200/440 AC	125/250 DC
250	Allis Ch.	2200/440 AC	350 DC
200	Whse.* (2)	220/440 AC	55 DC
200	G.E.*	220/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
150	Whse.	2200/440 AC	275 DC
105	Century b.b.	220/440 AC	70 DC
100	G. E.*	2200/440 AC	125 DC
100	Allis Ch.	220/440 AC	250 DC
100	Delco b.b.	220/440 AC	125/250 DC
80	Star* b.b.	220/440 AC	240 DC
60	Gen. Elec.*	220/440 AC	60 DC
60	Whse. (2)	220/440 AC	300 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Cr. Wh. b.b. (3)	220/440 AC	240 DC
40	G. E. (2)	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	600 DC
30	F. Morse b.b.	220/440 AC	24 DC
25	Whse.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	250 DC
15	El. Prod.	220/440 AC	40 DC
15	Star b.b.	220/440 AC	250 DC
12	M.C. b.b.	220/440 AC	125 DC

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CHICAGO 7, ILLINOIS
TELEPHONE MONROE 6-7409

3500 KW DIESEL ENGINE GENERATOR PLANT FOR SALE

Consisting of 5—1000 HP Busch Sulzer Diesel Engines, Serial Nos. 1043, 1044, 1045, 1074, 1075, Type 8-DB-24, 257 RPM, each with direct connected 700 KW Electric Machinery Company Generator, 2300 V. and accessories. Average running time on each of the sets approximately 40,000 hours.

Above generating equipment is housed in substantial brick building. Equipment is in excellent condition and is for sale as is on foundation at Chippewa Falls, Wisconsin for $160,000. Can be inspected in operation under load condition. No substation equipment included with above generating equipment.

USED OISC POWER TRANSFORMERS

Quan.	KVA	Phase	Mfg.	KV	Imped.	Approx. Serial Number	Price each F.O.B. Cars Storage Area Wisconsin	Weight lb.
15	100	1Ø	G.E.	33-7.2/12.47	5.2	5661818	$ 450	3,800
6	100	1Ø	Wagner	33-7.2/12.47	6.	275098	450	
3	150	1Ø	G.E.	33-7.2/12.47	5.3	5714121	600	3,750
3	150	1Ø	Moloney	13.2-2.3/4.1	5.	577230	800	4,200
2	3000	3Ø	Standard	19/33-4.1	7.3	52476	9,000	32,950
1	3000	3Ø	G.E.	34.5-4.16	5.89	6407842	9,000	
3	100	1Ø	Line Mtl.	6.6-2.3	4.6	63494	400	
3	150	1Ø	West.	7.2-.240		4655138	900	

1—Step Voltage Regulator, G.E., Type MLT-32, 3Ø, 60 cycle, 390 KVA 4160 volts, Serial Numbers 6407853, Weight 1700 lb., $9,850.

1—Complete heating boiler, 200 HP, weight 15 tons. Working pressure 100 psi, 807 sq. ft. heating surface. This Ames Steam generator is complete with firing equipment & automatic controls. No. E-43043. Cat. No. A200, Serial Number 56477 complete with Crane outlet valve, Powell B.O. valve, Lonergan pop valves, transformer, switch, wrenches, fuse block regulator, One 10 HP motor, one 1½ HP motor. Unit mounted on steel skid for easy placement. Overall dimensions 16'9" x 8'6" x 9' high. Used one season. Price F.O.B. Cars Genoa, Wisconsin $6,900.

1—Carling Steam Turbine (used as spare for boiler feed pump) Type 20E, 50 HP, RPM 1750, Serial Number 6423, Steam Pressure at throttle 650 psi, 825°. Estimated weight 1,000 lb. Manufactured by Carling Turbine Blower Company; Price F.O.B. Genoa, Wisconsin $400.

Inquire at

DAIRYLAND POWER COOPERATIVE

LA CROSSE, WISCONSIN

LAND'S 45th YEAR

MOTORS & GENERATORS, etc.

1 YEAR GUARANTEE

Partial Listing ONLY!

1000 KVA PYRANOL BANK

3—333 KVA GE type H form K2DA, 1 ph 60 cycle transformers 13800 volts primary, 460 volts secondary, ser. #6417472—3 & 4.

SYNCHRONOUS CONDENSER

1250 KVA Westg., 480 volts, 1200 RPM, with 15 KW direct connected Exciter. Late modern. Complete.

125 VOLT DC GENERATORS

KW	Make	Speed
200	West.	900
150	Westg.	1200
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
50	Westg. (2)	1150

250 VOLT DC GENERATORS

KW	Make	Speed
750	G. E. (2)	NEW
300	West. (2)	900
250	Cr. Wh.	1200
200	El. Mchy.	900
150	G. E.	1200
125	G. E. (2)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150

Motor Generator Set Headquarters

Any Voltage or Frequency

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L.J. LAND INC.

148 GRAND STREET

NEW YORK 13, N. Y.

Est. 1910 — 44th YEAR

DIESEL GENERATOR SETS

3—1400 HP Superior 8 cyl. 360 RPM 1000 KW Elec. Mchy. 3/60/2400 volt generators. Complete Plant. New 1949.

2—750 HP Superior 8 cylinder, 400 RPM, 500 KW Elec. Mchy. 3/60/440 volt generators & auxiliaries.

MISSISSIPPI VALLEY EQUIPMENT CO.

507 Locust St. St. Louis 1, Mo.

FOR SALE

WATER PUMPS

Water Booster 150 GPM to 750 GPM Circulating Hot water and many others.

100 TON CARRIER CENTRIFUGAL REFRIGERATION UNIT

Used for chilling brine to minus 10° F. Turbine driven 250 HP Moore steam Turbine direct drive 4500 to 6600 RPM 150# steam Pressure. Freon 11 complete with pumps, etc.

ONE COMPLETE TURBO-GENERATOR UNIT

Kerr Turbine, 2000 RPM, 160# Steam pressure complete with Throttle, Governer, Oil Pump Etc.

Fort Wayne Electric D.C. Generator, Type TR 2000 RPM, 150 KW., 600 Amps, Volts 115/230 Full Load.

MOTOR-GENERATOR SET

Type AR—150 HP 3 Phase 60 Cycle. 1760 RPM —440 Volt with Trumbull Type A enclosed safety switch. Allis Chalmers Auto-Transformer Manual Motor Starter. DC Generator Type TR 2000 RPM, 150 KW., 600 Amps, Volts 115/230 Full Load.

INSPECTION INVITED — INQUIRIES INVITED

HENRY FORD HOSPITAL **DETROIT 2, MICH.**

1000 KW NON-CONDENSING TURBINE GENERATOR

1250 KVA—1000 KW, 80% PF, General Electric alternating current generator, 3 phase 60 cycle, 2300/480 volt, 3600 RPM, direct connected to a:

1000 KW General Electric non-condensing steam turbine, 125-150#, 10-15# gauge back pressure.

Direct connected exciter, switchboard, instruments and spare parts.

UTILITIES MACHINERY CORP.

1965 E. SIXTH ST., CLEVELAND 14, OHIO

O'Brien Offers—

MOTOR GENERATOR SETS

1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW GE—MPC—230 V. 1200 rpm, 435 Syn. 3/60/2400 V.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
1—100 KW G.E. RC 17, 125 v. 3/60/220/1200 rpm
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph. any voltage.
2—70 KW Century, 1000 amp, 70 volt, 3/60/220/440
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW G.E.—CD-105—250 V. 75 HP KT 537—3/60/440
1—6 KW G.E. 6 v. 100 amp. 3/60/220
1—4000 Amp. 10 volt H.V.W. 600 rpm, 50 HP Syn. M.D. 3/60/220
1—2500 Amp 12 V. H.V.W. 600 rpm, 50 HP Syn. M.D. 3/60/220

DIESEL GENERATOR SETS

3—625 KVA Inger. Rand, 3/60/480/720 rpm
2—438 KVA GM-Winton 3/60/2300/360 rpm
375 KVA GM 8-268 Diesel 3/60/440
2—312 KVA Worth. CC-6, 3/60/220/450 rpm
300 KW GM 8-268 Diesel 125/250 V. D.C.
187 KVA GM Twin Diesel 3/60/220 New
100 KVA Murphy Diesel 3/60/220-440
56 KVA Climax Gas 3/60/220
30 KVA LeRoi Gas 3/60/220
45 KVA Chrysler Diesel 3/60/220
25 KVA LeRoi Gas 1/60/120/240
1—10 KW Wincharger 1/60/110-220 Gasoline

BOILERS

1—60,000# Erie Stoker New 160 psi
1—500 HP Cleaver Package 200 psi, New, 1953—never used
1—350 HP Cleaver Package 150 Lb.—1942
1—300 HP Keeler CP—300 Lb. Stoker—1950
2—250 HP Keeler Type CP-160 Lb.—1948
1—250 HP Ames Package Type (1948) 150 psi
2—200 H Springfield Sec. H. dr. 400 psi
1—188 HP CP Keeler W.T. 1942 Oil 160 lb. W.P.
1—100 H Verticle Hand Fired 100 lbs. Working Pressure
1—100 HP Clayton Forced Recirculation Compact Self-Contained and Fully Equipped for Operation 160 lb. W.P.
1—35 HP O and S Scotch Hand Fired 100 lbs. W.P.
1—25 HP Dowtherm Vaporizer
5—18 HP Red-Line New Horizontal Oil Fired 150 lbs. W.P.

ELECTRIC MOTORS

QU.	HP	Make	Type	Volts	Speed
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
1	350	G.E.	MT18	2300	400
2	200	West.	CW	2300	1800
1	200	G.E.	I.M.	440	514
1	150	G.E.	I.M.	440	600
1	150	G.E.	K T	440	600
1	125	West.	Syn. 3 brg.	550	600
1	100	Al. Ch.	Sl. Rg.	2200	900
1	100	West.	CS	440	1200
1	100	West.	CW	440	900
1	100	G.E.	I.K.	2200	1200
1	50	G.E.	M T	440	1200

TURBO GENERATORS

1—11250 KVA G.E. 3/60/13200/3600 rpm—Condensing—Boilers—Complete Plant
2—4000 KVA Allis Chalmers 3/60/2300/3600 rpm—Condensing
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

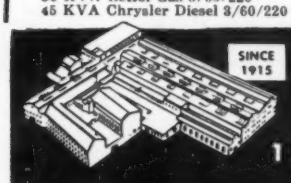
AIR COMPRESSORS

1—1690 CFM Sullivan W. J. 3.22x13x16
1—1600 cfm IR PRE-2 Syn. Mtr. Dr. 3/60/2300—100 psi.
2—1300 cfm IR-PRE-2 3/60/2300—100 psi
1—978 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr. Dr. 3/60/2300
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7⅛x5x4, 100 psi
1—173 CFM Chicago NSB 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	2000	G.E.	13200	230/460	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
1	750	O'Brien (New)	13200	480	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	West. (1945)	33,000	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
3	250	Al. Ch.	13,200	115/230	1
2	250	West. Dry	13800	230	1
3	150	West	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1
3	100	West.	4160	240/480	1
3	85	West.	4160	120/240	1

"Everything from a Pulley to a Powerhouse"



SINCE 1915

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T. M. REGISTERED U. S. PATENT OFFICE

PHILADELPHIA'S LEADING MACHINERY DEALERS & EXPORTERS

1547 N. DELAWARE AVE., PHILADELPHIA 25, PA.

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AFFILIATED WITH SOC EXPANSO INDUSTRIAL SUL AMERICANA LTDA RIO DE JANEIRO—BRASIL

MOTORS · MG SETS

All guaranteed for one year.

Qty.	HP	Make	Voltage	Speed
12	3000	West.	525/600	600 RPM
28	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	900	Elliott	230	300/195 RPM
3	800	West.	525/600	600/900 RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G.E.	230	480/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	350	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	220	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

All motors designed for mill reversing service.

Smaller sizes also in stock.

Motor Generator Sets In Stock
100—2000 KW Capacity

All of above is modern late type equipment remanufactured & tested by our engineers.

Write. Wire. Phone

A.G. SCHOONMAKER CO., INC.
50 CHURCH ST. NEW YORK 7, N. Y.

Plants: SAUSALITO (S.F.) CALIF., JERSEY CITY, N.J.

12 SPECIALS

2125 KVA G.E. 3/60/2300 v.—Elliott Cond. TURBO.
1560 KVA Wghse. 3/60/2300 v Mon. Cond. —Bleeder TURBO unit
625 KVA Al Chal TURBO unit, non-cond. 3/60/480/240 v.
250 KVA (2) Wghse 3/60/480/240 v—7 cyl. DIESEL units
200 KVA (2) GE. 480/240 v—Buckeye 6 cyl. Diesels
1226 KVA F.M. DIESEL Unit 300 R.P.M. 33D16
800 HP (2) B&W 250# BOILERS
680 HP (4) B&W 260# BOILERS
500 HP (3) B&W 160# low head BOILERS
300 HP (2) Keeler 250# PACKAGE BOILERS
300 (2) B&W 160# low head BOILERS
250 HP (2) B&W 225# low head BOILERS

POWER PLANT EQUIPMENT CO.
39 CORTLANDT STREET NEW YORK, N. Y.

PACKAGE TYPE—WATERTUBE
BABCOCK & WILCOX
INTEGRAL FURNACE TYPE
15,000 #/Hr.—250# W.P.
New Tubes—New Refractories
FS-4242, POWER
330 W. 42 St., New York 36, N. Y.

BREW WOLTMAN *Offers—*

Many years experience and service in POWER EQUIPMENT

—Specializing In

Turbo Units	Steam Engine Units	Synchronous Condensers
Diesels	Rotary Converters	Synch. & Ind. Motors
Boilers	Motor Generator Sets	Oil & Air Circuit Breakers
Transformers	Frequency Changers	Feeder Voltage Regulators

Your inquiries stating your needs will receive our careful and prompt attention

BREW, WOLTMAN & CO., INC., 50 Church St., New York 7

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	2200	Whse.	450
500	2200/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
400	2200/440	G. E.	720
300	440	G. E. (heist)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
200	440/220	Whse.	514
150(2)	440/220	G. E.	720
150	2200/440	G. E.	600
135	440/220	G. E. (mine)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
375	440/220	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G. E.	TS	720
300	2200/440	G. E.	TS	1200
250	2200/440	G. E.	TS	720
250	440/220	Whse.	HR	277
250	440/220	G. E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200/4000	Elliot	SC	1800
500	2200	G. E.		450
400	2200/480	Whse.	CS	720
300	2200	L. Allis	FS	1800
225(2)	2200/440	G. E.	KT	1200
200	440	G. E.	IK	720
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
200	2200	G. E.	KT	1800
150	440/220	Whse.	CS	900
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	2200/440		KT	600

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 480/220 V., G.E.
1—225 kva, 600 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm, 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E.
1—FKR-143, 1200 amp., 4500 V., G.E., Sol. op. (new)

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	Whse.	SK	1750
100	230	Whse.	SK	400/1200
90	230	G. E.	CD	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
125	G. E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250

TRANSFORMERS 60 Cy.

1—600 kva, Standard, 13,800-2300 V., 3 ph.
3—500 kva, Whse., 66000—2300 V.
3—333 kva, G. E., 12000—2300 V.
3—300 kva, G. E., 2300—575 V.
3—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—480/240 V.
3—150 kva, Al. Chal., 2400—240/480 V.
6—100 kva, Whse., 2400—120/240 V.

only partial listing

STEPHEN HALL & CO.

HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

30 TON BRIDGE CRANE

65 ft. span—Northern Engineering Co. Fish belly fabricated—travel motor—trolley motor—30 ton hoist—15 ton auxiliary hoist motor. All 230 volt DC motors—mfg. by G.E.—cab controlled with G.E. controls. Can be seen in operation.

IMMEDIATE DELIVERY

THE BOSTON METALS CO.
313 E. Baltimore Street
Baltimore 2, Md.
Curtis 7-5050

FOR SALE
2—B & W STERLING WATER TUBE BOILERS

Class 111-M-30—4 drum ASME 350 lb working pressure fitted with foster wheeler water cooled walls, induce draft and force draft, 6600 sq ft heating surface, used only 4 years sell at a bargain.

AMERICAN MACHINE CO.
PO Box 661, Oakland, Calif.

DIESEL GENERATOR SETS

200 KW General Motors Model 8-268A, 8 Cyl., 3/60/440 volts, 1200 RPM, Inc. Switchboard & Accessories.
100 KW G.M. Model 3-268A, 3 Cyl., 2 Cy., 3/60/440 V., 1200 RPM. Panel.
Overhauled. Other sizes in stock.

ALJON ELECTRIC DIESEL CO.
904 Pacific St. Brooklyn 38, N. Y.
STerling 3-6515

MOTORS FOR SALE

150 HP, 900 RPM, 220/440 volt, 3 phase, 60 cycle, Totally Enclosed, Fan Cooled, Continental Motor. UNUSED.

150 HP, 1800 RPM, 440 volt, 3 phase, 60 cycle, Frame K556. General Electric Motor. UNUSED.

FLUSHING ELECTRIC CORP.
45-07 162 St., Flushing 58, N. Y.

FOR SALE
DETROIT ROTOSTOKER

4 units nearly new used 1 year. Power dump grates complete set spare parts, 60000/hr. Westinghouse steam Turbine 50 H.P. 150 W.P. 2047 R.P.M. 300 ft. #825 Elevator Chain.

MICHIGAN CHEMICAL CORP.
St. Louis, Michigan

HYDRO ELECTRIC UNITS
COMPLETE VERTICAL TYPE

2300 volt—3 ph—60 cycle
One unit 400 KW on 36 ft. head
One unit 230 KW on 11 ft. head

SORENSEN GOVERNOR SERVICE
264 Kossuth St., Bridgeport, Conn.

These "Searchlight" advertisements

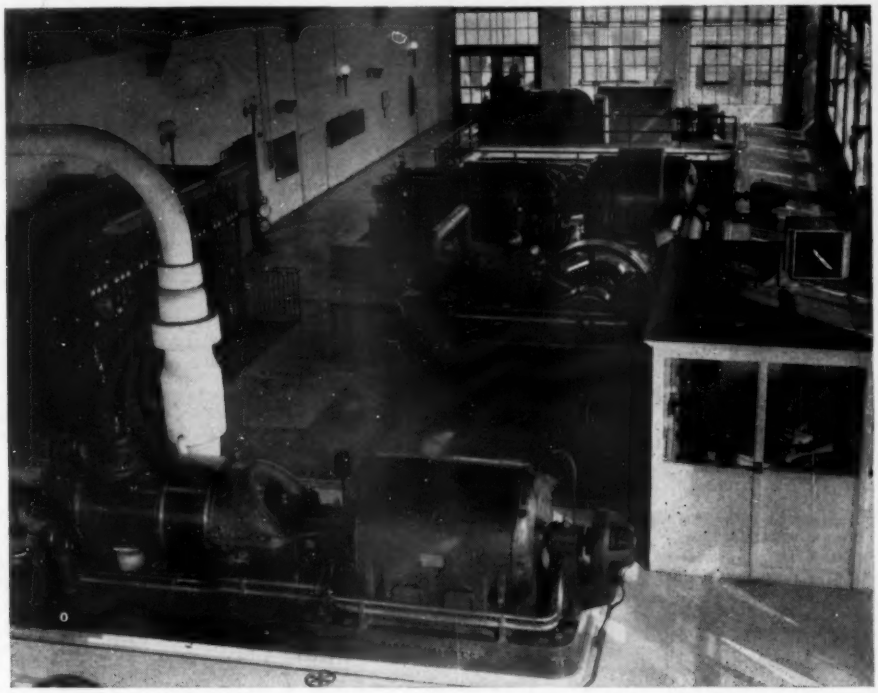
are live opportunities in the Power field.

Each announcement represents a current Want or Offering of an organization or individual in the field. Some have money-saving possibilities, others are opportunities for more business; many are employment opportunities; still others offer equipment — used or surplus new.

"Searchlight" advertisements are constantly changing. New opportunities are constantly finding their way into this great Want medium, each issue. Regular reading of the "Searchlight" pages can be as important to you as reading the editorial sections; Editorial matter is news of the industry; Advertising is NEWS OF OPPORTUNITIES offered in the industry.

for EVERY business WANT "Think SEARCHLIGHT first"

FOR SALE



Complete 6500-KW Power Plant Consisting of the Following Principal Items

1—3000-KW Allis-Chalmers condensing high-pressure steam turbine generator unit. 3600 r.p.m. impulse reaction type turbine direct connected to two-pole 60-cycle 3-phase 2300-4600 volt generator.
Throttle steam pressure lb. gauge 400.
Total throttle steam temperature 600°F.
Exhaust steam pressure 28″ vacuum.
Installed new 1949. (Including auxiliaries.)

1—1500-KW Allis-Chalmers turbo-generator, 2300 volts, 60-cycle, 3-phase. Installed new 1927. (Including auxiliaries.)

2—1000-KW Allis-Chalmers turbo-generators, 2300 volts, 60-cycle, 3-phase. Installed new 1918. (Including auxiliaries.)

1—Set of Metal Clad Switchgear and control panels, for the above turbines.

1—50,000 lbs. per hr., 450 psi. Union Iron Boiler including Detroit Roto Stokers with traveling grates and complete auxiliaries. Installed new 1949.

2—35,000 lbs. per hr. 200 psi. Union Iron Boilers including Detroit Roto Stokers and complete auxiliaries. Installed new 1935 and 1937.

Inspection site:

BURROUGHS CORPORATION
6071 SECOND AVENUE
DETROIT, MICHIGAN

The above equipment, including all allied accessories, will be sold to highest bidder on a *package* basis under sealed bids. Bids will be opened at 10 a.m. December 10, 1954, in offices of Burroughs Corporation, 6071 Second Avenue, Detroit 32, Michigan. Bid forms may be obtained by writing said corporation, attention, Mr. F. Pomerville. Only bids submitted on such forms will be considered. Equipment is open to inspection and will be in operation during part of November, 1954. Successful bidder must dismantle and remove equipment at his (its) expense before July 1, 1955. Certified check of 10% of the amount bid will be required to accompany all bids submitted in this sale.

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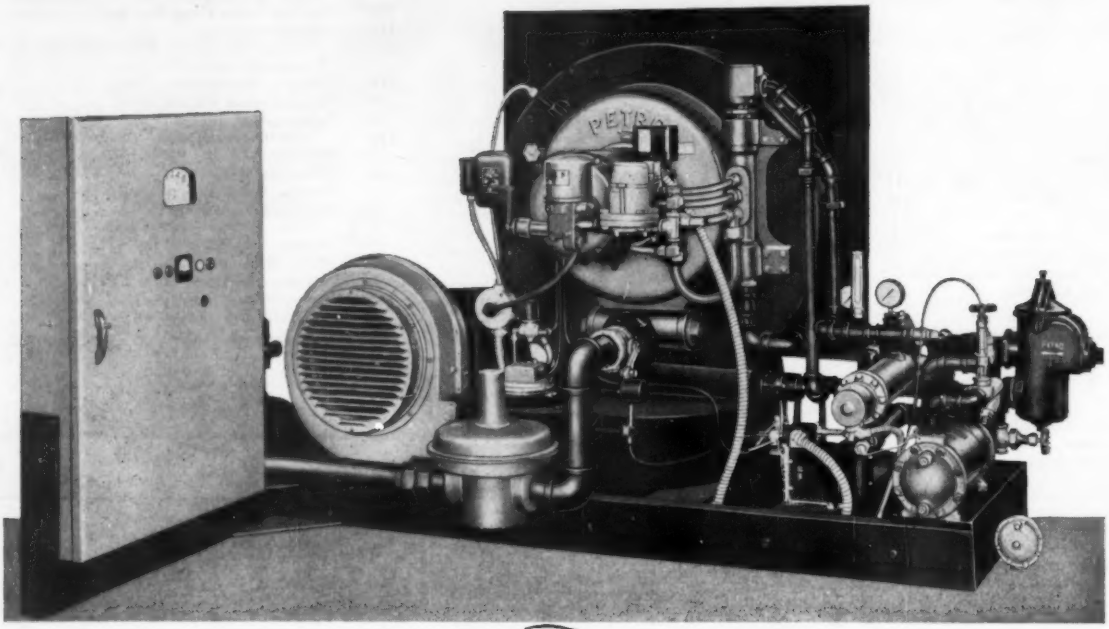
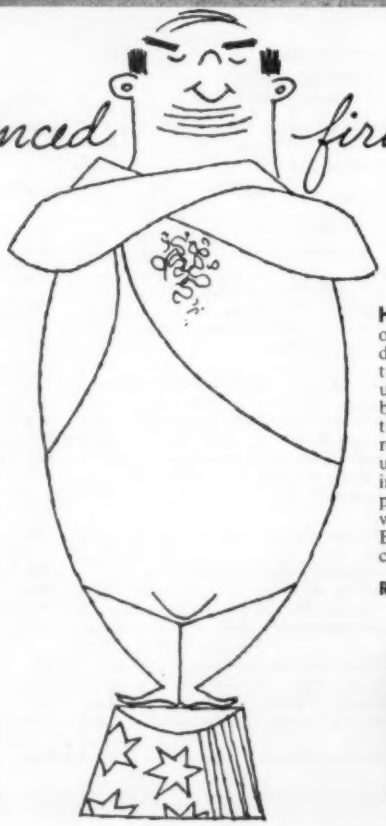


a perfectly-balanced firing system . . .



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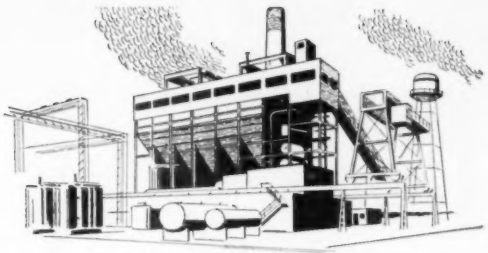
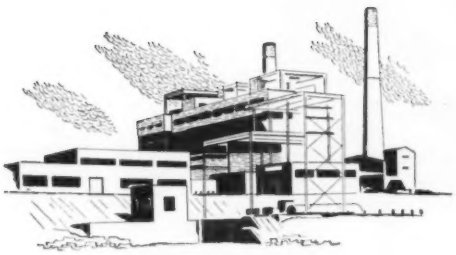
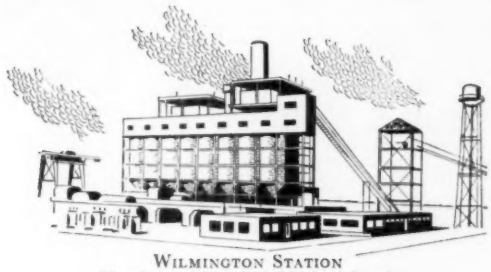


GOLDSBORO STATION
Total capability 169,000 kw.



LUMBERTON STATION
Total capability 185,000 kw.



WILMINGTON STATION
Total capability 230,000 kw. (est.)

Grinnell piping products have played a vital role in the construction of

7 NEW UNITS IN 7 YEARS

for Carolina Power & Light Company

HERE IS THE RECORD!
(Completion dates)
1949 . . . Lumberton Station, Unit #1
1950 . . . Lumberton Station, Unit #2
1951 . . . Goldsboro Station, Unit #2
1952 . . . Goldsboro Station, Unit #1
1952 . . . Lumberton Station, Unit #3
1954 . . . Wilmington Station, Unit #1
(Scheduled completion date)
1955 . . . Wilmington Station, Unit #2

Main steam line in WILMINGTON plant, fabricated by Grinnell, and supported by Grinnell Model R Constant-Support Hangers.

Since 1949, Carolina Power & Light's modernization and improvement program has been in full swing. Over this 6-year period, 6 new steam-electric generating units have been added to the system, with another scheduled for completion early in 1955. And very significantly, in each of these seven new units, Grinnell Prefabricated Piping and Grinnell Engineered Hangers have been employed, *exclusively!*

This continuous use of Grinnell Piping Products over the years means that Grinnell has successfully passed the most exacting test of all . . . the "test" of actual performance . . . on the job . . . day-in and day-out.

Piping fabricated in Grinnell shops is done under ideal conditions, with modern equipment, by personnel qualified for each class of work. Included in the price (which is determined in advance) are such items of expense as: interpretive engineering, shop sketches and planning, procurement of materials, power services, expendable tools and supplies. There are no charges for waste material or spoilage. All piping is rigidly inspected and tested to comply exactly with customer specifications and applicable codes. Consult Grinnell on your next piping job.

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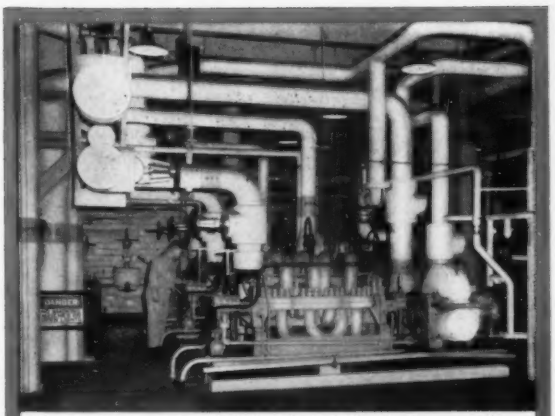
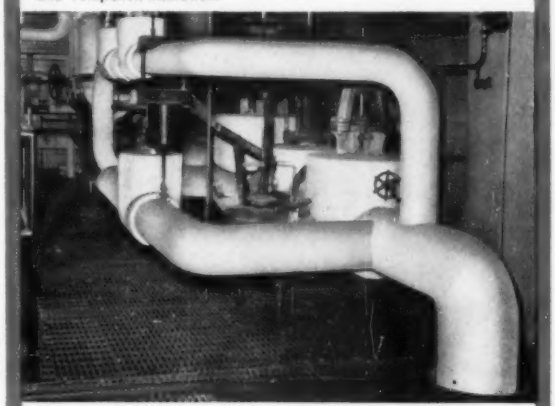
Carey super-light 85% Magnesia and Tempchek help "wrap up" new 20,000 KW Jamestown Plant

Efficiency in every single operation is a must at this plant in order to meet steadily increasing power loads. That's why Carey Super-Light 85% Magnesia and Carey Tempchek were the No. 1 choice for insulating plant boilers and piping throughout the entire new 20,000 KW installation. Fuel economy, maximum thermal efficiency are assured with these time-tested Carey products. They excel in efficiency, strength, workability and light weight . . . stand up under all kinds of humidity, vibration and water conditions . . . save space!

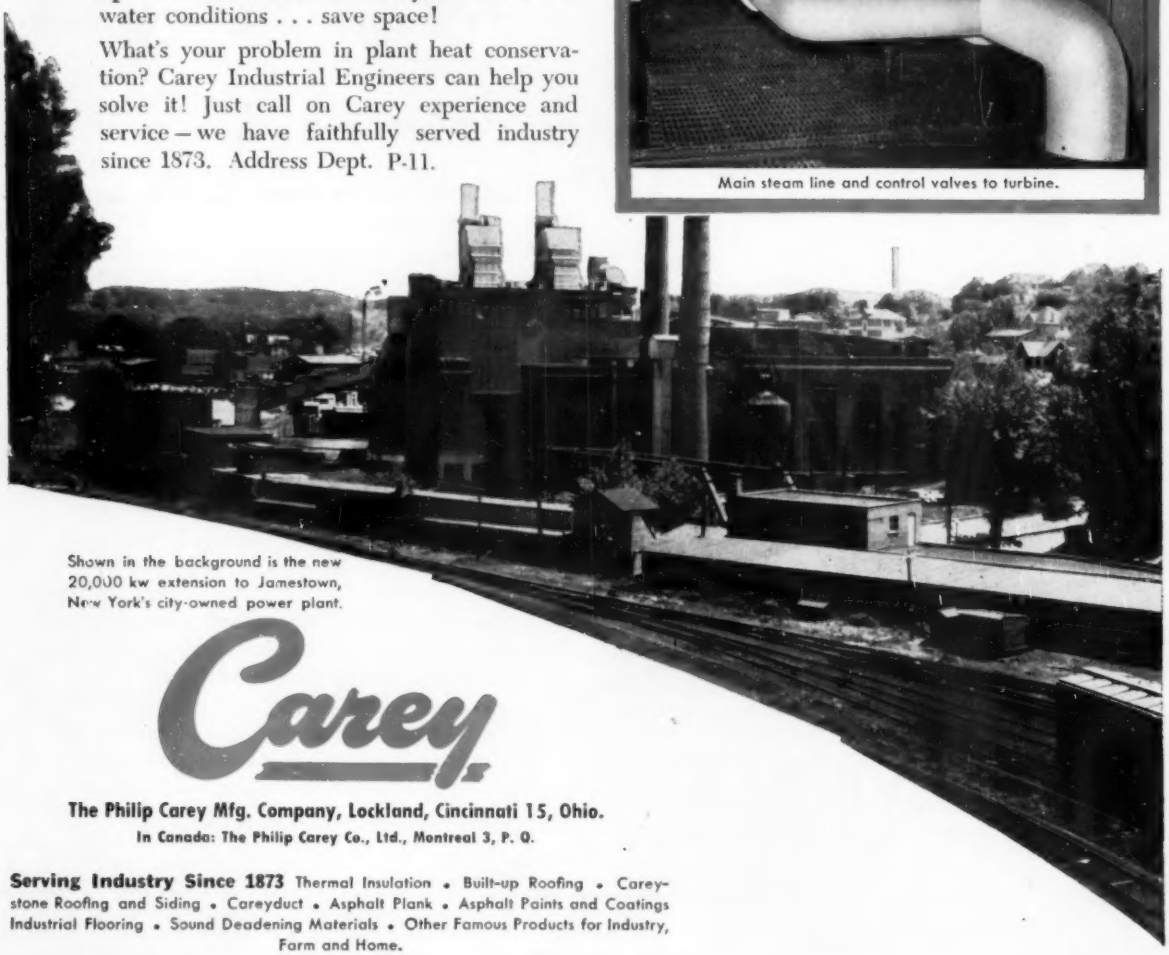
What's your problem in plant heat conservation? Carey Industrial Engineers can help you solve it! Just call on Carey experience and service — we have faithfully served industry since 1873. Address Dept. P-11.



The feedwater system includes three boiler feed pumps, four closed stage heaters, one de-aerating heater, and an evaporator. All piping is covered with Carey 85% Super-Light Magnesia and Tempchek insulation.



Main steam line and control valves to turbine.



Shown in the background is the new 20,000 kw extension to Jamestown, New York's city-owned power plant.

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